

**FINAL
SAMPLING AND ANALYSIS PLAN
VOLUME II
QUALITY ASSURANCE PROJECT PLAN**

**FOR THE
US OIL RECOVERY SUPERFUND SITE
AREA OF INVESTIGATION 1
400 N. RICHEY STREET
PASADENA, TEXAS**

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QUALITY ASSURANCE PROJECT PLAN

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES.....	iv
LIST OF FIGURES	v
LIST OF APPENDICES.....	v
LIST OF ACRONYMS	vi
QAPP DISTRIBUTION LIST.....	viii
1.0 INTRODUCTION	1
2.0 PROJECT MANAGEMENT.....	3
2.1 PROJECT ORGANIZATION	3
2.2 PROBLEM DEFINITION/BACKGROUND	6
2.3 PROJECT DESCRIPTION.....	8
2.3.1 Data Needs Analysis.....	8
2.3.2 Data Collection Activities.....	8
2.4 QUALITY OBJECTIVES AND CRITERIA	10
2.4.1 Data Quality Objectives.....	10
2.4.1.1 DQO Step 1: State the Problem.....	10
2.4.1.2 DQO Step 2: Identify the Goals of the Study	12
2.4.1.3 DQO Step 3: Identify Information Inputs.....	12
2.4.1.4 DQO Step 4: Define Boundaries of the Study	12
2.4.1.5 DQO Step 5: Develop the Analytical Approach.....	14
2.4.1.6 DQO Step 6: Specify Performance or Acceptance Criteria.....	15
2.4.1.7 DQO Step 7: Develop the Detailed Plan for Obtaining Data	17
2.4.2 Field and Analytical Quality Objectives.....	17
2.4.2.1 Field Measurements.....	18
2.4.2.2 Laboratory Analyses.....	18
2.4.3 Data Quality Indicators and Performance Criteria	18
2.4.3.1 Precision	19
2.4.3.2 Accuracy	19
2.4.3.3 Completeness.....	20
2.4.3.4 Representativeness.....	21
2.4.3.5 Comparability	21
2.4.3.6 Sensitivity	22
2.5 SPECIAL TRAINING/CERTIFICATION.....	22
2.6 DOCUMENTATION AND RECORDS	23
2.6.1 Field Operation Records	23
2.6.2 Laboratory Records	24
2.6.3 QA/QC Records.....	24
2.6.4 Laboratory Data Reporting Package Format	25
2.6.4.1 Fate and Transport Analyses	25
2.6.4.2 COPC Analyses	26
2.6.5 Data Archiving and Retrieval	28

TABLE OF CONTENTS (continued)

2.6.5.1	Project Records.....	28
2.6.5.2	Laboratory Records	28
3.0	DATA GENERATION AND ACQUISITION	29
3.1	SAMPLING PROCESS DESIGN	29
3.1.1	Sampling Rationale and Design.....	29
3.1.2	Sampling Schedule	29
3.1.3	Critical and Non-Critical Samples.....	29
3.1.4	Sampling Variability.....	30
3.2	SAMPLING METHODS.....	30
3.2.1	Sample Volume, Containers, and Preservation	30
3.2.2	Response to Sampling System Failure	30
3.3	SAMPLE HANDLING AND CUSTODY	30
3.3.1	Field Custody Procedures.....	31
3.3.1.1	Response to Failures in Field Custody Procedures.....	32
3.3.2	Laboratory Custody Procedures	32
3.3.2.1	Sample Receipt and Inspection.....	32
3.3.2.2	Internal Tracking and Numbering	33
3.3.2.3	Laboratory Storage Areas	34
3.3.2.4	Laboratory Custody Transfers	34
3.4	ANALYTICAL METHODS	35
3.4.1	Field Measurements.....	35
3.4.2	Laboratory Analyses.....	35
3.4.2.1	Fate and Transport Analyses	35
3.4.2.2	COPC Analyses	35
3.4.2.3	Requirements for Sample Disposal	36
3.4.3	Response to Analytical System Failure	36
3.5	QUALITY CONTROL.....	36
3.5.1	Field QC Checks.....	36
3.5.1.1	Level of Field Quality Control Effort.....	36
3.5.1.2	Field Duplicates	37
3.5.1.3	Equipment Rinsate Blanks.....	37
3.5.1.4	Trip Blanks	37
3.5.2	Laboratory QC Checks.....	38
3.5.2.1	Level of Laboratory Quality Control Effort	38
3.5.2.2	Laboratory Duplicates	39
3.5.2.3	Laboratory Control Samples and Laboratory Control Sample Duplicates.....	39
3.5.2.4	Matrix Spikes and Matrix Spike Duplicates	39
3.5.3	Response to Failures in Quality Control.....	40
3.6	INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE.....	40
3.6.1	Field Instrument/Equipment Testing, Inspection, and Maintenance	40
3.6.2	Laboratory Instrument/Equipment Testing, Inspection, and Maintenance.....	41
3.7	INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY	41
3.7.1	Field Instrument/Equipment Calibration	41
3.7.2	Laboratory Instrument/Equipment Calibration.....	42
3.8	INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES.....	43
3.8.1	Traceability of Standards	43
3.8.2	Storage of Standards	43
3.9	DATA MANAGEMENT.....	43

TABLE OF CONTENTS (continued)

3.9.1	Data Recording	44
3.9.2	Data Handling.....	44
3.9.3	Data Verification and Validation.....	45
3.9.4	Data Analysis.....	45
3.9.5	Data Archiving and Retrieval	45
4.0	ASSESSMENT AND OVERSIGHT	46
4.1	ASSESSMENTS AND RESPONSE ACTIONS	46
4.1.1	Performance and System Audits.....	46
4.1.1.1	Field Performance and System Audits	46
4.1.1.2	Laboratory Performance and System Audits	47
4.1.2	Corrective Action	47
4.1.2.1	Field Corrective Action	48
4.1.2.2	Laboratory Corrective Action.....	48
4.1.2.3	Corrective Action during Data Verification and Validation.....	49
4.2	REPORTS TO MANAGEMENT	50
4.2.1	Laboratory Data Report	50
4.2.2	Reports to Project Management.....	50
5.0	DATA VALIDATION AND USABILITY	51
5.1	DATA REVIEW, VERIFICATION, AND VALIDATION.....	51
5.2	VERIFICATION AND VALIDATION METHODS	51
5.2.1	Procedures Used to Verify and Review Field Data	51
5.2.2	Laboratory Procedures Used to Verify and Review Data.....	51
5.2.3	Third-Party Verification and Validation.....	52
5.2.3.1	Data Verification for Metals.....	53
5.2.3.2	Data Review for Organic Compounds.....	53
5.2.3.3	Data Validation.....	54
5.3	RECONCILIATION WITH USER REQUIREMENTS	54
6.0	REFERENCES	56

LIST OF TABLES

<u>Table</u>	<u>Title</u>
1	Data Quality Objectives for AOI-1
2	Analyte List and Preliminary Screening Values for Groundwater and Surface Water – Metals
3	Analyte List and Preliminary Screening Values for Groundwater and Surface Water – Herbicides and Pesticides
4	Analyte List and Preliminary Screening Values for Groundwater and Surface Water – Semi- Volatile Organic Compounds
5	Analyte List and Preliminary Screening Values for Groundwater and Surface Water – Volatile Organic Compounds
6	Analyte List and Preliminary Screening Values for Groundwater and Surface Water – Total Petroleum Hydrocarbons
7	Analyte List and Preliminary Screening Values for Soil and Sediment – Metals
8	Analyte List and Preliminary Screening Values for Soil and Sediment – Herbicides and Pesticides
9	Analyte List and Preliminary Screening Values for Soil and Sediment – Semi-Volatile Organic Compounds
10	Analyte List and Preliminary Screening Values for Soil and Sediment – Volatile Organic Compounds
11	Analyte List and Preliminary Screening Values for Soil and Sediment – Total Petroleum Hydrocarbons
12	Summary of Field Measurements
13	Fate and Transport Analytical Protocols
14	Quality Control Performance Criteria for COPC Analyses
15	Data Qualification Criteria
16	LCS, MS/MSD and Surrogate Precision and Accuracy for COPC Analyses
17	Quality Control Performance Criteria for Fate and Transport Analyses
18	Containers, Preservatives, and Holding Times – Aqueous Samples
19	Containers, Preservatives, and Holding Times – Solid Samples
20	Laboratory Electronic Data Deliverable Format

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>
1	Site Location Map
2	Site Vicinity Map
3	Project Organization
4	Human Health Preliminary Conceptual Site Model
5	Ecological Preliminary Conceptual Site Model

LIST OF APPENDICES

<u>Appendix</u>	<u>Title</u>
A	Data Verification and Validation Standard Operating Procedure
B	(Reserved for Plan Addenda)

LIST OF ACRONYMS

AOC	Administrative Order on Consent
AOI	Area of Investigation
ASTM	American Society for Testing and Materials
ASTs	Aboveground storage tanks
BHHRA	Baseline Human Health Risk Assessment
COC	Chain-of-custody
COPCs	Constituents of Potential Concern
CPR	Cardiopulmonary Resuscitation
CPT	Cone Penetrometer Testing
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FSP	Field Sampling Plan
GC/MS	Gas chromatography/mass spectrometry
HASP	Health and Safety Plan
HRSC	High-resolution Site Characterization
ICP/MS	Inductively-coupled plasma/mass spectrometry
ID	Identification
LCS(D)	Laboratory Control Sample (Duplicate)
LIMS	Laboratory Information Management System
LOAEL	Lowest observed adverse effect level
MDL	Method Detection Limit
$\mu\text{g}/\text{m}^3$	micrograms per cubic meter
MQL	Method Quantitation Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NELAC	National Environmental Laboratory Accreditation Conference
NIST	National Institute of Standards and Testing
OSHA	Occupational Safety and Health Administration
OVM	Organic Vapor Meter
NOAEL	No observed adverse effect level
NPL	National Priorities List
PBW	Pastor, Behling & Wheeler, LLC
PCSM	Preliminary Conceptual Site Model
PDF	Portable Document Format
ppbv	Parts per billion by volume
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
PSV	Preliminary Screening Value
QA	Quality Assurance
QAALLC	Quality Assurance Associates
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation

LIST OF ACRONYMS (continued)

ROST	Rapid Optical Screening Tool
RPD	Relative Percent Difference
RPM	Remedial Project Manager
r	Correlation coefficient
RRF	Relative Response Factor
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SDL	Sample Detection Limit
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SOW	Statement of Work
SQL	Sample Quantitation Limit
SVOCs	Semivolatile Organic Compounds
TCEQ	Texas Commission on Environmental Quality
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
USOR	US Oil Recovery
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds
WRNs	Work Plan Refinement Notices

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1.0 INTRODUCTION

The US Oil Recovery (USOR) Superfund Site (the Site) is comprised of three separate parcels of land located on North Richey Street in Pasadena, Harris County, Texas, in an industrial area situated north of Highway 225 (Figures 1 and 2). The Site consists of:

- Area of Investigation 1 (AOI-1, also referred to as the USOR Property), located at 400 North Richey Street (Figure 2); and
- Area of Investigation 2 (AOI-2, also referred to as the City of Pasadena/MCC Property), located at 200 North Richey Street (Figure 2) (two separate properties).

When the Site was last operational, it was known as US Oil Recovery LP and operated as a used oil processing and waste treatment facility (USOR LP and related entities herein referred to as “USOR LP”). The Site was proposed to the National Priorities List (NPL) on September 16, 2011, and was placed on the National Priorities List on September 18, 2012. An Administrative Settlement Agreement and Administrative Order on Consent (Removal Action AOC) for a Removal Action for the Site (both AOI-1 and AOI-2) was executed by certain Potentially Responsible Parties (PRP Group, or Respondents) and the U.S. Environmental Protection Agency (EPA) on August 25, 2011. An AOC for the AOI-1 Remedial Investigation/Feasibility Study (RI/FS) was executed by the Respondents and the EPA effective on May 14, 2015. Note that the term RI/FS as used in this document references plans and anticipated work only at AOI-1.

This Quality Assurance Project Plan (QAPP) was prepared in accordance with Paragraph 27(b) of the Statement of Work (SOW) for the AOI-1 RI/FS, included as Appendix B to the RI/FS AOC. The QAPP was prepared by Pastor, Behling & Wheeler, LLC (PBW) and Quality Assurance Associates (QAALLC), on behalf of the USOR PRP Group (the PRP Group or Respondents). The QAPP format and elements have been developed in accordance with the following guidance:

1. EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 (EPA/240/B-1/003, March 2001; Reissued May 31, 2006)
2. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5 (EPA/240/R-02/009, December 2002)

This QAPP presents the project objectives and organization, functional activities, and quality assurance/quality control (QA/QC) protocols that will be used to achieve the level of data quality acceptable for the RI/FS. This document should be used in conjunction with the RI/FS Work Plan (RI/FS WP) (PBW, 2015a), which presents the initial evaluation of existing AOI-1 data and background information and presents

a summary of the work to be performed during the RI/FS, and the RI/FS Field Sampling Plan (FSP) (PBW, 2015b), which gives specific sampling locations, equipment, and procedures to be used during the RI/FS.

2.0 PROJECT MANAGEMENT

2.1 PROJECT ORGANIZATION

The management organization for the RI/FS and the key personnel assigned to the project are shown on Figure 3, and the project management team members, along with identification of the key personnel assigned to the project, are described in the following sections.

EPA Remedial Project Manager (RPM). The EPA RPM is the primary point of contact within the EPA for the project. The EPA RPM is responsible for the overall direction of the project in accordance with the provisions of the RI/FS AOC and the RI/FS WP, FSP, and QAPP.

USOR Project Coordinator. The USOR Project Coordinator will provide the principal point of contact and control for matters concerning the project and field investigation implementation. In consultation with the Respondents (the USOR PRP Group Steering Committee and USOR PRP Group Technical Committee), the USOR Project Coordinator will:

- Coordinate field investigation activities and develop a detailed schedule;
- Establish project policies and procedures to meet the specific objectives of the project;
- Review the work performed on each project to help ensure its quality, responsiveness and timeliness; and
- Represent the project team at meetings and public hearings, if necessary.

RI/FS Manager. The RI/FS Manager will direct and supervise the RI/FS work. The RI/FS Manager's responsibilities will be to review all RI/FS project work to ensure that it meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed herein. The RI/FS Manager is responsible for developing staffing requirements, orienting field staff concerning the project, and developing mechanisms to review and evaluate each work product. Additionally, the RI/FS Manager will be responsible for maintaining the official, approved QAPP, and distributing the QAPP and any subsequent QAPP revisions, addenda, and amendments to the individuals named in the distribution list.

Site Safety Officer. The Site Safety Officer will be responsible for overall health and safety practices associated with the field work. Specific functions and duties will include the following tasks:

- Establish the requirements of the project Health and Safety Plan (HASP) (PBW, 2015c);
- Arrange or conduct audits of field activities to ensure that proper health and safety procedures are being used; and
- Communicate with the RI/FS Manager, Field Investigation Manager, and field technical staff

concerning project issues related to health and safety.

Human Health Risk Assessment Manager. The Human Health Risk Assessment Manager will direct and supervise human health risk assessment activities. The Human Health Risk Assessment Manager will provide input to the development of the RI/FS WP and will direct human-health risk-related data evaluation activities. The Human Health Risk Assessment Manager's responsibilities will be to ensure that human health risk assessment work meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed in the RI/FS WP, FSP, QAPP, and HASP.

Ecological Risk Assessment Manager. The Ecological Risk Assessment Manager will direct and supervise ecological risk assessment activities. The Ecological Risk Assessment Manager will provide input to the development of the RI/FS WP and will direct ecological-health risk-related data evaluation activities. The Ecological Risk Assessment Manager's responsibilities will be to ensure that ecological risk assessment work meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed in the RI/FS WP, FSP, QAPP, and HASP.

Field Investigation Manager. The Field Investigation Manager will be responsible for the field work performed as part of a specific RI/FS activity. Duties of the Field Investigation Manager will include:

- Maintaining field records;
- Continually surveying the work area for potential work hazards and relate any new information to RI/FS personnel at the Tailgate Safety Meeting held each day prior to beginning field activities;
- Ensuring that field personnel are properly trained, equipped, and familiar with standard operating procedures (SOPs) and the HASP;
- Overseeing sample collection, handling and shipping; ensuring proper functioning of field equipment; and
- Informing the laboratory when samples are shipped to the lab and verifying samples arrived at the lab.

The primary duty of the Field Investigation Manager is to ensure that the field sampling is performed in accordance with the FSP and the QAPP. The Field Investigation Manager will also require that appropriate personal protective equipment will be worn and disposed of according to the HASP. In addition, the Field Investigation Manager may be responsible for preparing monitoring reports for review by the RI/FS Manager.

FS Manager. The FS Manager will direct and supervise FS activities, including development and implementation of any treatability studies, assembling of remedial action alternatives and evaluation of these alternatives in the FS. The FS Manager's responsibilities will ensure that FS activities meet the specific project goals, meet technical standards, and are in accordance with the objectives and procedures discussed in the RI/FS

WP, FSP, QAPP, and HASP.

QA Manager. The QA Manager will assist in preparation of the QAPP, review the associated FSP, and provide technical assistance in the resolution of QA/QC or analytical chemistry issues. Other responsibilities include an evaluation of sampling procedures, laboratory analyses, and project documentation with respect to the QAPP requirements. The QA Manager will oversee the review of laboratory data packages and preparation of data validation reports in conformance with the requirements of the QAPP. The QA Manager will remain independent of direct involvement in day-to-day operations, but will have direct access to staff, as necessary, to resolve any QA issues. The QA Manager has sufficient authority to stop work on the investigation as deemed necessary in the event of substantive QA/QC issues. Independent QA management will be provided by QAALLC. Specific functions and duties include:

- Performing QA audits on various phases of the project's operations, as necessary;
- Reviewing and approving the QAPP and other QA plans and procedures;
- Reviewing validation of data collected relative to RI/FS activities and the QAPP; and
- Providing QA technical assistance to project staff.

The QA Manager will notify the Respondents' Project Coordinator of particular circumstances that may adversely affect the quality of data and ensure implementation of corrective actions needed to resolve nonconformances noted during assessments.

Laboratory Project Manager. The Laboratory Project Manager will be responsible for ensuring laboratory resources are available to PBW as needed for the project and will provide oversight of final laboratory reports. The Laboratory Project Manager will oversee performance of analytical tests conducted as part of the project. The Laboratory Project Manager is responsible for providing the Field Investigation Manager a confirmation of sample receipt and for notifying the Field Investigation Manager of any sample integrity issues (holding time exceedance, chain-of-custody [COC] discrepancies, etc.) promptly when discovered. The Laboratory Project Manager is also responsible for internal laboratory review of data for adherence to the requirements of the project QAPP, the laboratory QA Manual and SOPs. The Laboratory Project Manager is also responsible for submitting the final data package, including the electronic data deliverable, within the requested turnaround time.

Contractors. Numerous contractors will be utilized during the RI/FS investigation to complete the required RI/FS tasks. Contractors will be required to prepare a HASP for their personnel and associated activities, in compliance with the HASP prepared for the investigation, and adhere to the applicable requirements of the RI/FS WP, FSP, and QAPP to ensure work is performed appropriately. The following is a list of the types of

US Oil Recovery Superfund Site

contractors and their responsibilities. Other contractors will be used during the RI/FS, as necessary.

Environmental Drilling: The environmental drilling contractor will be responsible for providing the personnel and equipment necessary to conduct drilling related tasks identified in the RI/FS WP. These tasks include:

- Cone penetrometer testing (CPT) or the rapid optical scanning tool (ROST);
- Advancing boreholes for monitoring well and soil borings (hollow-stem auger and direct push, respectively);
- Construction of monitoring wells and surface completions;
- Decontamination of drilling equipment;
- Submittal of state required well registrations;
- Plugging and abandonment of wells (if necessary); and
- Obtaining necessary drilling permits and implementing traffic control plans when drilling in public right of ways.

Sediment/Surface Water/Tissue Sampling: Off-site sediment, surface water and tissue samples, if needed, will be collected by a contractor with experience in the collection and processing of sediment samples from channels and bayous as well as ultra-clean water collection techniques. The contractor will have a Texas Parks and Wildlife Department collection permit for biological samples.

Surveying: The location and elevation of newly installed soil boring, CPT/ROST, and monitoring wells, and any other relevant features, will be surveyed for position by a professional Texas-licensed surveyor. The surveyor will be responsible for providing appropriate technical drawings and electronic data in accordance with Section 5.9 of the FSP.

Site Maintenance: General mowing and maintenance of the USOR Property is provided by a local contractor. The contractor provides equipment and personnel to mow, clear brush and shrubs from the fence line, and make minor repairs to fencing.

2.2 PROBLEM DEFINITION/BACKGROUND

The approximately 12.2 acre USOR Property was most recently used as a used oil processing and waste treatment facility by USOR LP. USOR LP began operations on the property around June 2003 and acquired the property in December 2003. Prior to 2004, multiple businesses operated on the property including chemical manufacturing companies (specializing in fertilizers and/or herbicides/pesticides), a cow hide exporter, and a leather tanner. Section 2.2 of the RI/FS WP contains a more detailed listing of the operational history of the property.

USOR LP had ceased operations in June of 2010, prior to the state-court appointed Receivership in July of 2010. An office building, security guard shack, and large warehouse (approximately 25,000 square feet in size) are present on the property. The warehouse includes a former laboratory, machine shop, parts warehouse, and a material processing area that included a filter press. More than 1,000 drums and poly totes containing various industrial wastes were present within the warehouse but have since been removed by contractors under the direction of the PRP Group. A tank farm with approximately 32 aboveground storage tanks (ASTs) and various sumps containing industrial wastes located within secondary containment is present at the north end of the warehouse. A large, concrete-walled aeration basin (also called the bioreactor) was formerly located west of the tank farm but was removed as part of an EPA-approved removal action. A stormwater containment pond is located west of the warehouse and south of the former aeration basin. Approximately 225 roll-off boxes are located on the USOR Property; however, wastes left in the roll-off boxes by USOR LP have been removed and properly disposed. An inactive rail spur enters the south-central part of the USOR Property from the south and extends north along the west side of the warehouse. A utility right-of-way with various pipelines is present within the southern part of the USOR Property and pipelines are also present outside of but adjacent to the USOR Property along the eastern and western sides.

Currently, the USOR Property is enclosed within a six-foot chain link security fence with locked gates; security cameras have been installed and access is monitored by a security contractor.

The Preliminary Assessment Report prepared by the Texas Commission on Environmental Quality (TCEQ) (TCEQ, 2011) for AOI-1 indicated that complete pathways may exist at AOI-1 for:

- 1) Groundwater - due to potential releases to groundwater at AOI-1;
- 2) Surface water - due to releases via surface water runoff from AOI-1 to Vince Bayou;
- 3) Soil - due to spills/releases at AOI-1 during historic industrial operations, and
- 4) Air - due to reported releases of hazardous substances in air downwind of AOI-1.

The HRS Documentation Record (EPA, 2011) for AOI-1 contained the following conclusions:

- 1) Hazardous substances present at the property and in waste materials previously handled at the property include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, herbicides, and metals;
- 2) Identified and observed on-going releases of hazardous substances were occurring from the AOI-1 property into Vince Bayou through stormwater runoff; and
- 3) The predominant threat to human populations, animals or the food chain is the potential for exposure by direct contact with VOCs, metals, flammables, corrosives, and unknown waste material at AOI-1 and in nearby Vince Bayou and its sediments.

The overall issue to be addressed by the RI/FS is to evaluate the nature and extent of contamination resulting from operations at the USOR Property, to obtain data to fill data gaps in the Preliminary Conceptual Site Model (PCSM) for the USOR property, to assess the risk from potential contamination at the USOR Property to human health and the environment, and allow the development and evaluation of remedial alternatives, if warranted.

Consistent with the potential issues at AOI-1 and EPA guidance, the specific objectives of the RI/FS are to: (1) characterize site conditions; (2) evaluate the nature and extent of the contamination; (3) assess the risks to human health and the environment; (4) identify remedial action objectives for those chemicals and media posing an unacceptable risk; (5) develop preliminary remediation goals (PRGs) to address the remedial action objectives; (6) develop, screen and evaluate potential remedial technologies consistent with the PRGs; (7) examine the potential performance and cost of the remedial alternatives that are being considered; and (8) summarize and present the data so that an appropriate remedy, if warranted, consistent with CERCLA, can be selected by EPA.

2.3 PROJECT DESCRIPTION

2.3.1 Data Needs Analysis

As presented in the RI/FS WP Section 3.4, a data needs analysis was conducted for the RI/FS. The data needs, which are summarized in Table 11 of the RI/FS WP, were developed for AOI-1 based on an evaluation of the potentially complete pathways identified in the PCSMs (Figures 4 and 5 of this QAPP) and an analysis of the information needed to assess the completeness of these pathways. The data needs summary illustrates the data needs evaluation process by noting the conceptual model exposure routes that were judged to be indeterminate or complete and potentially significant, identifying the specific data needs for determining whether that pathway is complete and significant, listing the existing data that were reviewed as part of an initial evaluation, and conceptually describing the RI activities to be performed to fill the identified data need. The conceptual descriptions of RI activities in this table were then used to develop the framework of the RI/FS tasks described in Section 5.6 of the RI/FS WP and summarized in Section 2.3.2 below.

2.3.2 Data Collection Activities

The PCSMs, the conceptual descriptions of RI/FS activities in the data needs summary table (Table 11 of the RI/FS WP), and the data quality objectives (DQOs) in this QAPP were used to develop the initial RI/FS data collection activities and sample locations described in the following sections. As noted in the RI/FS WP (Section 5.6), the first iteration of data collection will focus on on-property (defined as the area inside the

existing fence at the USOR Property) environmental media (i.e., on-property soil, on-property groundwater, on-property surface water and on-property sediment) and off-property (defined as the area outside of the existing fence at the USOR Property) soil and groundwater. This is due to the nature of the USOR Property where the source areas are located topographically higher than some of the potential receptors and potential impacts are primarily related to the movement of constituents of potential concern (COPCs) from the USOR Property to the receptors via surface drainage. Furthermore, receptors in Vince Bayou and Little Vince Bayou also are potentially impacted from the other documented industrial activities within the Vince Bayou and Little Vince Bayou watershed. In this regard, the determination of the impacts from the USOR Property, versus those from other sources of contaminants to Vince Bayou and Little Vince Bayou, must be carefully determined through the iterative progression of investigation activities beginning on the USOR Property and adjacent properties and working toward Vince Bayou and Little Vince Bayou and including a comprehensive background study for media of potential concern (see below). This approach will allow for the allocation of the relative contributions of COPCs to Vince Bayou and Little Vince Bayou among the multiple potential sources.

The project will involve sampling environmental media using standard sampling tools and techniques including, but not limited to:

- Surface soil sampling by trowel, hand auger, hollow stem auger, or direct push tools;
- Subsurface soil sampling by hollow stem auger or direct push tools;
- Groundwater sampling by low-flow sampling, pumps or bailers;
- Sediment sampling by trowel, bucket auger, Ponar grab, Eckman grab, piston or push core;
- Surface water sampling by dip sampler, sample bottle or pump; and
- Fish or shellfish sampling using seines, nets, gill nets, traps, or by hand.

High-resolution site characterization (HRSC) techniques will be incorporated into the AOI-1 groundwater investigation, e.g., CPT or ROST (or other methods, as required). Details of the HRSC investigation are provided in FSP Section 3.6.1.

The RI/FS WP and FSP provide a detailed description of the proposed data collection activities. The FSP provides sample locations, analyses to be performed, methods for sample collection, field measurements to be performed, etc.

2.4 QUALITY OBJECTIVES AND CRITERIA

2.4.1 Data Quality Objectives

DQOs were developed as part of the systematic planning process to define the type and quality of the data sufficient to characterize the USOR Property, conduct human health and ecological risk assessments, and perform the evaluation of remedial alternatives. The DQOs, therefore, support the rationale for the USOR Property investigation strategy and approach detailed in the RI/FS WP and FSP. The data quality details of the DQO process are documented in the following sections of this QAPP.

The DQOs have been developed in general accordance with the “Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4” (EPA, 2006). When data are collected during the RI/FS, the EPA-recommended systematic planning tool is the DQO process. The DQO process is a seven-step planning approach to develop sampling designs for data collection activities that support decision-making. The seven steps of the DQO process described by EPA are:

- 1) State the problem;
- 2) Identify the goals of the study;
- 3) Identify the information inputs;
- 4) Define the boundaries of the study;
- 5) Develop the analytical approach;
- 6) Specify performance or acceptance criteria; and
- 7) Develop the plan for obtaining data.

In accordance with the above seven step process, the following sections contain the DQOs that were developed for the exposure routes and associated data needs identified in the RI/FS WP. The first four steps of the DQO process are summarized for each exposure medium on Table 1 of this QAPP.

2.4.1.1 *DQO Step 1: State the Problem*

Problem Description

A general problem statement for the USOR RI/FS is as follows (Table 1):

Historical USOR Property information suggests that contamination exists in on-property soil in areas of former operations, and that COPCs may have migrated to groundwater and/or off-property during unauthorized releases, spills and overland runoff following storm events.

Because of the gradual topographic slope at the USOR Property, if COPCs were transported from the property, they would most likely migrate from the USOR Property to the east or north, deposit onto the

surface soils in these areas and either remain in those soils or be transported further down-slope. Vince Bayou surface water and sediment would be the potential endpoint of transport and migration of USOR Property-related COPCs. Due to the highly industrialized nature of the surrounding area and the numerous possible point- and non-point sources of COPCs in Vince Bayou and Little Vince Bayou unrelated to the USOR Property, it is difficult to identify the USOR Property-related COPCs without a thorough and complete understanding of on-property source characteristics and the transport/migration pathways off-property.

Preliminary Conceptual Site Model

The PCSMs (Figures 4 and 5 of this QAPP) convey what is known about the sources, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors, and risks; and identify the potential exposure medium. The PCSMs were developed based on the review of relevant USOR Property information and with input from the PRP Group and EPA. Data collected during the RI/FS will be used to verify and revise the models as necessary.

Planning Team

The planning team involved in the development of the RI/FS Study includes the regulatory agencies (EPA and TCEQ), the PRP Group (Respondents), and the team responsible for executing the project (consultants, risk assessors, quality assurance professionals). Other interested parties (community groups, other stakeholders, adjacent landowners) may also provide input to the planning process. An organizational chart is included as Figure 3.

Resources and Schedule

As described in detail in Section 2.0 of the RI/FS WP, information resources regarding USOR property history, potential source areas, potential COPC migration pathways, and potential human and environmental receptors include reports prepared by EPA, TCEQ, and previous consultants; other historical documents in the administrative record compiled by EPA; historical aerial photographs; and observations made through multiple visits to the USOR Property.

Personnel resources are shown on the organizational chart included as Figure 3.

The preliminary RI/FS schedule is shown on Figure 10 of the RI/FS WP.

2.4.1.2 DQO Step 2: Identify the Goals of the Study

Principal Goals of the Study

The principal goal of the AOI-1 RI/FS is as follows (Table 1):

Conduct an investigation and assess the potential risks posed by releases of chemicals associated with the USOR Property, assess potential human health and ecological risks associated with past USOR property activities, and develop remedial alternatives to address any unacceptable risks.

Based on this principal goal, specific study questions and alternative actions were developed per DQO guidance for each of the potential exposure medium, as shown on Table 1.

2.4.1.3 DQO Step 3: Identify Information Inputs

The RI/FS has been designed to obtain the data necessary to accomplish the principal study goal and answer the specific study questions identified in DQO Step 2. The data needed (i.e., the information inputs) to accomplish the goals and answer the specific study questions are listed in Table 11 of the RI/FS WP and in Table 1 of this QAPP for each of the potential exposure media. Existing information and data from the USOR Property were reviewed to help develop the scope of the RI/FS activities to be performed to address the identified data needs. These general investigation activities were then refined into the specific data collection methods listed in Table 11 of the RI/FS Work Plan and in Table 1 of this QAPP. These sampling, analysis, and data evaluation methods have been selected to generate legally defensible data that will satisfy the RI/FS objectives.

2.4.1.4 DQO Step 4: Define Boundaries of the Study

Temporal Boundaries

The temporal boundaries for the RI/FS are the time periods from the initial sampling activities to the completion of data collection activities necessary to satisfy the study goals. A preliminary RI/FS schedule is provided as Figure 10 of the RI/FS WP. Temporal variability in RI/FS data will be evaluated during the RI/FS. For soil, temporal variability of COPC concentrations is not anticipated given that the potential sources of COPCs are being addressed through removal actions. Temporal variability of COPC concentrations in groundwater will be evaluated by the performance of multiple groundwater sampling events, if necessary, and indicated by the data and hydrogeologic conditions. No specific seasonal or daily

variability that would significantly impact data collection is anticipated, but variability will be evaluated based on USOR Property characteristics (e.g., tidal influences on shallow groundwater).

Spatial Boundaries

Spatial boundaries for each of the potential exposure medium are listed on Table 1. Consistent with the iterative approach to data collection as defined in the RI/FS WP, the lateral boundaries of the study are initially represented by the on-property area (i.e., the area within the existing fence) for soil, groundwater, surface water, and sediment (See Section 5.6 and Figure 9 of the RI/FS WP; and Table 1 of this QAPP). The spatial boundaries for on-property surface water and sediment are thought to be restricted to the southwestern portion of the USOR Property where ponded water exists. After review of the on-property data, off-property soil and groundwater data collection will be performed in the adjacent areas, as also proposed in the RI/FS WP and shown on Table 1 of this QAPP. The spatial (lateral and vertical) boundaries for data collection for off-property surface water, sediment, and fish/shellfish in Vince Bayou and Little Vince Bayou will be defined after review of the on- and off-property soil, groundwater, surface water, and sediment data. Background data collection activities will be performed in areas beyond the identified lateral extent of COPCs in soil, surface water, and/or sediment, as dictated by the data.

The preliminary lower vertical boundary of the RI/FS study is the base of the uppermost water-bearing zone underlying AOI-1. The lower vertical boundary for soil is the top of the uppermost water-bearing zone. The following intervals define the surface, shallow and subsurface soil boundaries:

- Surface soil - 0 to 0.5 feet below ground surface;
- Shallow soil - 0.5 to 5.0 feet below ground surface; and
- Subsurface soil – greater than 5.0 feet below ground surface.

It is anticipated that the entire study area will be evaluated as a single unit in the baseline human health risk assessment (BHHRA) to evaluate site-wide risk; however, if the site data and exposure scenarios indicate that there are distinct areas of concern, those areas will be evaluated separately. Exposure point concentrations may be represented by the 95% UCL or the maximum detected concentration depending on the data set for an area. Potential human health exposures within various environmental media (e.g., soil, groundwater) will be summed across those media when appropriate, within those spatial boundaries (e.g., on-property or off-property). For the screening-level ecological risk assessment (SLERA), the small depressed drainage area on-site will be evaluated as an intermittently wet habitat with the rest of the on-site habitat area evaluated as upland terrestrial. The off-site portion of the SLERA will address the transitional area to the bayou and the bayou itself.

2.4.1.5 DQO Step 5: Develop the Analytical Approach

As stated above, the principal goal of the RI/FS at AOI-1 is to assess the potential risks posed by releases of chemicals associated with the USOR Property, assess potential human health and ecological risks associated with past USOR property activities, and develop remedial alternatives to address any unacceptable risks. This goal will largely be accomplished by measuring the concentrations of COPCs in relevant environmental media (soil, groundwater, surface water, sediment, biota, and air) and comparing the concentrations to preliminary screening values (PSVs), as described below.

COPC Extent Evaluation

The initial use of the concentration data will be to evaluate the spatial extent of COPCs in environmental media, which will be accomplished by evaluating the data against PSVs as discussed in Section 5.6 of the RI/FS Work Plan. The PSVs for the several groups of COPCs are provided in Tables 2 through 11 of this QAPP. The extent evaluation will be made by comparing the outermost sample COPC concentrations on a point-by-point basis to the PSVs (taking into account background concentrations). Since these comparisons will be made on an individual basis by direct comparison (not statistically generated values) to the established PSVs, no statistical parameters (e.g., maximum, 95% upper confidence limit (UCL)) of a sample population or populations will be used for this purpose. Sampling and analysis methods have been selected to obtain detection limits sufficient to make these comparisons. Using the DQO process (EPA, 2006) and the information developed in this section, the theoretical decision rule developed for the comparison of COPC concentration data is described below:

If the concentration of a COPC in a media at the perimeter of the property or at an off-property sampling location exceeds the extent evaluation PSV, then collect additional samples for delineation. For interior on-property samples, the need for additional delineation will be made in the overall context of defining the nature and extent of contamination.

The PSVs are conservative screening criteria published by EPA and TCEQ, as noted in the footnotes for Tables 2 through 11.

Risk Assessment

The second use of the COPC concentration data will be to evaluate the risk to potential human and ecological receptors in the BHHRA, and SLERA, respectively. For the BHHRA this entails: (1) the comparison of the estimated carcinogenic risk for specific target receptors described in the CSMs to the Superfund discretionary risk range (1×10^{-4} to 1×10^{-6}); and (2) the comparison of non-carcinogenic hazard quotient values for these same receptors to the target hazard index value greater than one. To facilitate these calculations, a statistical

parameter is calculated for each potential receptor group. For the BHHRA, exposure point concentrations used for decision-making are conservative estimates, the 95% UCL on the mean. These parameters will be calculated for on-property receptors using on-property data, and for off-property receptors using off-property data. Thus, the theoretical decision rule developed for the BHHRA from the DQO process (EPA, 2006) is described below:

If the incremental cancer risk for a potential receptor exceeds the Superfund risk range, or the non-carcinogenic hazard quotient for a potential receptor exceeds one, then develop and evaluate remedial action objectives for that pathway/receptor/media.

The details of the ecological risk assessment process will be presented in a WRN, but are briefly outlined here. The ecological risk evaluation will be conducted in a stepwise fashion with the first step being a conservative screening step. For each detected COPC in each media, the maximum concentration will be compared to screening levels (see Tables 2-10 for screening levels). COPCs that are detected and considered bioaccumulative will be noted for further evaluation even if the maximum detected value is below the screening value. The COPCs that are detected and considered bioaccumulative or are detected at a concentration greater than the screening level will be considered COPCs for the next phase of evaluation.

The next phase of the ecological assessment will include a calculation of hazard quotients for each receptor guild based on the appropriate no observed adverse effect level (NOAEL)-based toxicity reference values and lowest observed adverse effect level (LOAEL)-based toxicity reference values. The exposure point concentration will be the lower of the maximum detected value or the 95% UCL. If the 95% UCL is calculated, it will include non-detected results. The theoretical decision rule developed for the ERA following the desktop evaluations described above from the DQO process (EPA, 2006) is described below:

If the hazard quotient for a potential receptor exceeds one, then either: 1) perform a more thorough desktop-based ecological assessment using additional media data; 2) continue the ecological risk assessment process to a BERA using site specific tissue data, toxicity data or other site-specific evaluation; or 3) make a risk management decision appropriate for the Site data and conditions.

2.4.1.6 DQO Step 6: Specify Performance or Acceptance Criteria

The purpose of this step is to define the quantitative limits that will be used in conjunction with the theoretical decision rules described in DQO Step 5. These criteria are used to identify potential error in the decision making process and to describe the means by which potential error will be reduced to acceptable levels. Since the intended use of the data collected during the RI/FS is for decision-making, as described in Step 5, the

statistical hypothesis testing approach (Step 6A in EPA, 2006) is used to specify acceptance criteria, as described below.

The first step in identifying acceptance criteria is to identify the types of decision errors that could be made in a statistical hypothesis test. There are four possible outcomes of a statistical test, two of which result in no decision error, and two of which represent the possible decision errors. The following table describes the possible outcomes of the statistical hypothesis tests. Please note that in the following discussion the term “action level” (per EPA, 2006) refers to a PSV for the RI/FS at AOI-1.

Conclusion reached after applying the statistical hypothesis test to the collected data	True Condition / Reality	
	COPC Concentration Exceeds Action Level	COPC Concentration is Less Than the Action Level
COPC Concentration Exceeds Action Level	Correct Decision	Decision Error – False Acceptance
COPC Concentration is Less Than the Action Level	Decision Error – False Rejection	Correct Decision

False Rejection – Type I error

A false rejection decision error occurs when the data leads to the decision that the COPC concentration level is less than the action level when, in reality, the COPC concentration exceeds the action level.

False Acceptance – Type II error

A false acceptance decision error occurs when the data leads to the decision that the COPC concentration level is greater than the action level when, in reality, the COPC concentration is below the action level.

The second step is to identify ways to reduce the probability of making decision errors. The likelihood of error in the statistical hypothesis test is reduced through the development and implementation of an appropriate FSP and QAPP, with methods and quality assurance procedures, including data validation, selected to minimize the Type I and Type II decision errors. The FSP and the QAPP are the fundamental tools for ensuring the generation of quality data and making sound decisions regarding the nature and extent of COPCs at AOI-1.

While it is not possible to totally eliminate the potential of a decision error, the consequences of decision error have been addressed by specifying sensitive analytical methods, using multiple lines of evidence from various site media, and selecting sampling locations representing the most heavily impacted regions of the study area. The design of this data collection program helps to reduce the consequences of making decision errors that would indicate that a particular COPC concentration did not exceed an action level when in reality it did. Sufficient analytical sensitivity, data review, additional samples, analysis of similar compounds, appropriate sample collection and analysis procedures will ensure that in spite of a particular decision error related to a

particular compound's concentration, the overall likelihood of adverse human or ecological effects as a result will be minimal.

The DQOs established for the AOI-1 RI/FS investigation have been selected to reduce the likelihood of decision errors and ensure appropriate decisions regarding the nature and extent of impacts at the Site are made. Consistent with EPA human health risk assessment guidance (EPA, 1989 and EPA, 2002b), the statistical parameter used for estimating exposure point concentrations in risk assessment is the 95% UCL on the mean. Per EPA guidance (EPA, 1997 and EPA, 2001b), maximum concentrations are used to represent exposure point concentrations for ecological receptors in the SLERA. As noted previously, COPC extent evaluations will be made using direct comparisons of individual sample concentrations to their respective PSVs.

2.4.1.7 DQO Step 7: Develop the Detailed Plan for Obtaining Data

The goal of DQO Step 7 is to develop a resource-effective design to collect the information identified in Steps 2 through 6 and therefore address the problem identified in Step 1. This design is presented in the RI/FS WP and the FSP. Alternative sampling designs and methods, including potentially less expensive methods, were considered as part of the sampling design process, but these alternatives were determined to either not provide data of the necessary quality, or were considered infeasible or impractical based on conditions at AOI-1. For instance, use of field analytical methods using field instruments for VOCs (OVM) and metals (X-ray fluorescence) were considered, but those approaches were not selected given the need for definitive data for risk assessment purposes, the need to perform laboratory analyses for other parameters (e.g., SVOCs, total petroleum hydrocarbons [TPH]), and the relatively small size of the USOR Property.

2.4.2 Field and Analytical Quality Objectives

Since measurements must be made so that results are of sufficient quality to support the project goals, which include site characterization, nature and extent of the contamination, and human health and ecological risk assessment, data should be collected using the following analytical approach:

- Collection – Samples will be collected using approved SOPs to minimize the random and systematic errors that can be introduced during the physical collection of the sample, sample handling, sample analysis, and data handling;
- Documentation – Sample custody will be documented to maintain security and show control during transfer of samples from collection through analysis to adequately establish and support the use of sample data in regulatory or legal actions;
- Laboratory – As stipulated in Section XI, Paragraph 54 of the RI/FS AOC, the analytical laboratory will have a documented quality system which complies with “EPA Requirements for Quality

Management Plans (QA/R-2)” (EPA/240/B-01/002, March 2001) or equivalent documentation as determined by EPA;

- Analysis – Field measurements will be generated using approved and documented standard procedures. Laboratory data for use in quantitative risk assessment must be definitive (i.e., generated using rigorous analytical methods such as an EPA-approved method, ASTM standard method, or laboratory method that is formally documented and demonstrated to be applicable); and
- QC – Measurement performance criteria for both field and laboratory QC will be based on the intended use and should be a function of sampling design, requirements in the analytical methods, and standard accepted practice.

2.4.2.1 Field Measurements

A preliminary list of potential field measurements to be taken during the RI/FS is provided in Table 12.

SOPs will be used for field measurements as shown on Table 12. SOPs are included in Appendix A of the FSP.

2.4.2.2 Laboratory Analyses

Fate and transport parameters, groundwater classification parameters, parameters required for adjustment of ecological benchmarks, etc. (collectively termed “fate and transport analyses”) data will not be used in the quantitative risk assessments, and thus analytical methodology has been selected to provide screening level data as shown on Table 13.

COPC concentration data will be used in quantitative risk assessment, and thus analytical methodology has been selected to provide definitive data with the additional consideration of method sensitivity. Tables 2 through 11 provide the selected analytical methodology and analyte lists along with the method quantitation limits (MQLs) and PSVs for the various media to be assessed (groundwater/surface water, soil/sediment). The MQL corresponds to the lowest non-zero concentration standard in the laboratory’s initial calibration curve and is based on the final volume of extract (or sample) used by the laboratory. The MQL should be less than the screening criteria for data that will be used in quantitative risk assessment. If it is not possible to achieve a MQL below the PSVs, then the standard available method with the lowest possible MQL should be used for that analyte.

2.4.3 Data Quality Indicators and Performance Criteria

Measurement performance criteria for both field and laboratory QC must be based on the intended use and should be a function of sampling design, requirements in the analytical methods, and standard accepted practice. Consequently, detailed performance criteria have been developed for data produced during analysis of COPC concentrations in the various media (soil, sediment, groundwater, surface water) in accordance with EPA and TCEQ methods, and limited performance criteria have been developed for data produced for fate

and transport analyses. The principal indicators of data quality are precision, accuracy, completeness, representativeness, comparability, and sensitivity. Quantifiable performance criteria have been developed for precision, accuracy, completeness, and sensitivity. Acceptable levels of non-quantifiable data quality parameters (i.e., representativeness and comparability) will be assured through the proper implementation of field and laboratory SOPs.

2.4.3.1 Precision

Precision is a measure of the reproducibility between two or more measurements of the same characteristic (i.e., analyte, parameter) under the same or similar conditions. Determining the agreement among replicate measurements of the same sample assesses the precision of the analytical procedure; combined precision of sampling and analysis procedures is assessed from the agreement between measurements of field duplicate samples. The relative percent difference (RPD) in the results will be calculated for each duplicate pair using the equations provided in Section 3.5. Data for duplicate analyses will be evaluated only if both of the samples in the duplicate pair have a concentration greater than the MQL.

Field Precision Objectives

Field precision will be assessed by collecting and analyzing field duplicates. The field precision goals are provided on Tables 14 through 16 for the analysis of COPC concentrations and on Table 17 for the fate and transport analyses.

Laboratory Precision Objectives

In accordance with method requirements, laboratory precision will be assessed by analysis of various duplicate sets (i.e., laboratory duplicates, laboratory control sample [LCS] duplicates, matrix spike duplicates [MSD]). Laboratory precision goals are provided on Tables 14 through 16 for the analysis of COPC concentrations and on Table 17 for the fate and transport analyses.

2.4.3.2 Accuracy

Accuracy is the degree of agreement or bias between an observed value (or an average of several values) and an accepted reference value. Deviations or biases from standard values result from cumulative inconsistencies in the measurement system. Potential sources of bias include (but are not limited to) sample collection, preservation, and handling procedures; matrix effects, and analytical procedures. Accuracy is expressed as percent recovery of spiked analytes, which will be calculated for each spiked sample using the equations provided in Section 3.5.

Field QC blanks and laboratory blanks will also be used to quantify the effect of sample contamination on overall accuracy.

Field Accuracy Objectives

Field accuracy will be assessed through the use of equipment and trip blanks and through the adherence to sample container, preservation, and holding time requirements. Equipment blank results will be used to assess potential sources of contamination resulting from sample collection activities and equipment decontamination. Results from the analysis of trip blanks will be used to assess the potential for sample contamination during sample shipment, handling, and storage. Accuracy objectives for blanks will be met if COPC concentrations are below MQLs in the equipment and trip blanks. Sample handling, preservation, and holding time requirements are listed on Tables 18 and 19 for aqueous and solid samples, respectively.

Laboratory Accuracy Objectives

In accordance with method requirements, laboratory accuracy will be assessed by the analysis of various spike samples (i.e., matrix spikes (MS), LCS, interference check samples, standard reference samples, and surrogates). Where required by the method, a LCS will consist of a standard purchased from a source other than that for the calibration standards. The use of an LCS will be based on the availability of an EPA, National Institute of Standards and Testing (NIST), or commercially certified LCS. Accuracy goals for laboratory QC samples are listed on Tables 14 through 16 for the analysis of COPC concentrations and on Table 17 for the fate and transport analyses.

2.4.3.3 Completeness

Completeness is expressed as the percentage of valid data points obtained from a measurement system or method. Completeness is affected by such factors as sample bottle breakage and acceptance/rejection of analytical results and will be re-calculated and presented in each validation checklist.

Field Completeness Objectives

Field completeness will be assessed for target parameters by comparing the number of valid field samples to the total number of field samples planned. The validity of field samples will be assessed by comparison of documented field practices to requirements of this QAPP and the accompanying FSP. The completeness goal for field samples is 90%.

Laboratory Completeness Objectives

The results of a laboratory analysis will be considered valid if predetermined data quality indicators are met or

exceeded for precision and accuracy. A data verification and validation, as described in Section 5, will be conducted to assess completeness requirements on an analyte-by-analyte basis for COPCs in the various media analyzed in accordance with EPA or TCEQ methods. Laboratory completeness will be assessed for COPCs by comparing the number of valid measurements to the total number of measurements. The laboratory completeness goal for all COPCs combined is 90% and the goal for each COPC individually is 80%.

2.4.3.4 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. As such, representativeness describes whether samples collected, or the aliquots selected by the laboratory for analysis, are sufficient in number, type, location, frequency, and size to be characteristic of the substance analyzed.

Measures to Ensure Representativeness of Field Data

Field representativeness is achieved by collecting a sufficient number of unbiased (representative) samples and implementing a QC program for sample collection and handling prior to analyses. The sampling approaches developed for this project, including the number of samples, sample locations, collection procedures, completeness requirements and other QC requirements will provide for samples that are representative of site conditions. In addition, collection of duplicate samples will provide a measure of the variability of analyte present in a particular sample volume and evaluation of equipment and trip blank results will ensure that analytical results are representative of sample concentrations.

Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory will be ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing duplicate samples. Additionally, evaluation of laboratory blank results will ensure that analytical results are representative of sample concentrations.

2.4.3.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared with another.

Measures to Ensure Comparability of Field Data

Comparability of field data will be assured by adhering to standard sampling procedures described in Section 5 and Appendix A of the FSP, using acceptable calibration standards; using standard measurement and

reporting units; and using the pre-determined acceptance criteria for precision and accuracy presented in this QAPP.

Measures to Ensure Comparability of Laboratory Data

Comparability of laboratory data will be assured by adhering to standard analytical procedures described in this QAPP, using traceable calibration standards; using standard measurement and reporting units; and using pre-determined acceptance criteria for precision and accuracy. All data that meet the QA objectives described in this document and are considered usable will be considered comparable data.

2.4.3.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. Analytical methods for COPCs have been selected based upon the sensitivity of the MQLs. To ensure data that will be used for quantitative risk assessment are usable, the method must be able to meet the risk assessment criteria or it must be the standard available method with the lowest possible MQL.

In order to achieve lower reporting limits, all detections above the method detection limit (MDL) will be reported as “J-flagged” values. Prior to sample analysis, the laboratory will conduct a detection limit study per EPA guidelines to establish MDLs obtainable by the laboratory for COPCs. Records of the study will be maintained at the laboratory and results of the study will be periodically updated and/or revised when changes in instrumentation or methods occur within the laboratory. Additionally, the laboratory MDLs will be checked for reasonableness. This can be accomplished by the analysis of a reagent matrix spiked by the laboratory with each analyte near, or within two to three times, the calculated MDL, and carried through the sample preparation procedures.

2.5 SPECIAL TRAINING/CERTIFICATION

All field personnel who will collect samples addressed by this QAPP will have completed a 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Operations training with annual 8-hour refreshers and medical monitoring. All personnel shall also have received 24-hours of supervised field training. The Field Investigation Manager shall have completed an additional 8-hour OSHA Supervisor training course. The Field Investigation Manager and Site Safety Officer shall hold a current certificate for first aid/cardiopulmonary resuscitation (CPR) training. Other training may be instituted as required. The RI/FS Manager will be responsible for assuring that required training is obtained and for maintaining records documenting the required training for inclusion in the final project file.

The project files shall contain documentation of the person's qualifications to perform the assigned tasks. Personnel performing stratigraphic interpretations and installing monitoring wells will be overseen by or licensed as Professional Geologists by the State of Texas. Contract laboratories will maintain training records and demonstration of proficiency documentation in the laboratory personnel files.

2.6 DOCUMENTATION AND RECORDS

Documents that describe, specify, report, or certify activities, requirements, procedures, or results will be produced during the RI/FS including project plans and reports as specified in the SOW, field operation records, laboratory records, and QA/QC records.

Project documents will be managed as described below.

2.6.1 Field Operation Records

Field operation records include (1) the collection records for field and QC samples, (2) SOPs, (3) corrective action reports for field activities, and (4) training/certification records for field personnel. Copies of these forms will be maintained in the final project file.

Sample collection will be documented and tracked using field forms and/or field logbook entries, and COC forms. Field personnel will complete these forms, which will then be reviewed for correctness and completeness by the Field Investigation Manager.

At each site, station IDs, location, sampling time, date, and sample collector's name/signature are recorded. If a field or lab QA/QC sample is to be collected at a site for a specific sample, this information will be documented on the field data sheets.

Values for all measured field parameters will be recorded. Observational data will be recorded, for instance water appearance, weather, biological activity in the sample, unusual odors, and other sample specific information.

COC forms will be completed for all samples collected.

Any problems or comments related to a specific sample will also be documented on the field data sheet. Such information would include moving a station location, if composites are generated from more than one discrete sample or if there were any circumstances at a site that prevented a sample from being collected.

Any corrective actions necessary to ensure that sample integrity is maintained will be documented. If field SOPs are violated or deviations are made, a corrective action report will be prepared to document what occurred, actions taken to correct the failure, as well as the effect of the action on the sample in question. Corrective action is discussed in Section 4.1.2.

Examples of field forms and procedures for completing each are included as PBW SOP No. 1 (Field Documentation) in Appendix A of the FSP.

2.6.2 Laboratory Records

Laboratory records will include all of the data in the data reporting package (described in Section 2.6.4). In addition to the items in the data reporting package, at a minimum, the following records (as appropriate) will be maintained by the laboratory:

- Sample preparation and analysis log books;
- Standard solutions preparation log books;
- Test method raw data and QC sample records;
- Raw data calculation worksheets;
- Standard reference material and/or proficiency test samples data;
- Temperature records for storage units (standards, samples);
- Equipment calibration and maintenance records; and
- Certification records for standards.

2.6.3 QA/QC Records

QA/QC records include this QAPP, the checklists produced during data validation, the reports from field and external laboratory audits, and corrective action reports covering QA/QC practices.

All QA audit reports, corrective action reports and validation checklists will be maintained by the RI/FS Manager for inclusion in the final project file with a copy retained by the QA Manager. The RI/FS Manager will be responsible for maintaining the QAPP for inclusion in the final project file and for distributing the QAPP to the persons listed on the distribution list.

Procedures or project activities may require modification to achieve project quality or data objectives, which may require amendments to this QAPP. Modifications may include items such as change of laboratory, methods, or QC samples. When the need for a modification is identified, the QA Manager will determine if the modification significantly impacts the technical and quality objectives of the project. If the modification is substantive as determined by the QA Manager, an amendment to the QAPP shall be prepared and submitted for approval by EPA (either as a revised complete document, or separate addendum). Appendix B has been reserved for addenda.

Amendments to the QAPP will be reviewed and approved in the same manner as the original document. The amendment should contain identifying information as presented on the original document title page and shall be submitted to any party holding a controlled copy of the QAPP. Amendments to the QAPP will be approved before the changes are implemented; however, verbal approval of modifications may suffice to expedite project work. Verbal approvals with a description of the modifications should be documented and retained in the project files, with the verbally approved modification documented in an amendment and submitted to EPA within a reasonable timeframe for formal signature approval.

The RI/FS Manager will be responsible for ensuring that all addenda are provided to the persons on the distribution list, such that they will have the most current approved version of the QAPP. Updates to the QAPP will be controlled through use of a revision header on each page. This header will note the date of the revision and the revision number followed by the revision letter (D for draft and F for final).

2.6.4 Laboratory Data Reporting Package Format

2.6.4.1 *Fate and Transport Analyses*

Laboratory data reports will consist of sample results plus the applicable QA/QC data specified below:

- The results of each analysis in correct units;
- Dates of sample collection, receipt, preparation, and analysis;
- Copy of the COC and sample receipt forms signed by the sample custodian;
- Complete method references for sample cleanup, preparation, and analysis;
- A laboratory review checklist and exception report with a discussion of any QA/QC non-conformances;
- Evaluation of holding time and sample preservation;
- Results of blank analyses;
- Results of laboratory duplicates and spike duplicates, expected values, control limits, and percent recoveries;
- Results of MS/MSD, unspiked sample ID, control limits, expected value, RPD, and percent recovery; and

- Results for LCS, expected value, control limits, and percent recovery.

2.6.4.2 *COPC Analyses*

A Laboratory Information Management System (LIMS) will be utilized for generation of laboratory data reports. The deliverables listed below will be required for all samples. Supporting data will be provided for those analyses where such information is available as requested by the RI/FS Manager. Laboratory data reports will consist of sample results plus the QA/QC data specified below. The laboratory will report COPC concentrations at or below the lowest possible reporting limits as constrained by high parameter concentrations requiring sample dilution or matrix interferences. Results reports shall include both the sample detection limit (SDL), which is the MDL adjusted to reflect sample-specific actions, and the sample quantitation limit (SQL), which is the MQL adjusted to reflect sample-specific actions. Adjustments include actions such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, and analytical adjustments. The MQL corresponds to the lowest non-zero concentration standard in the laboratory's initial calibration curve and is based on the final volume of extract (or sample) used by the laboratory. For single point calibrations, such as metals, the MQL is set based on project requirements with a low-level check standard at or below the MQL. Non-detected results shall be reported as less than the value of the SDL. The laboratory will report COPC concentrations less than the SQL but greater than the SDL and will flag such results as estimated values (J). Aqueous results shall be reported in mg/L. Soil data shall be reported in mg/kg and shall be corrected to a dry-weight basis. Soil gas and vapor data, if collected, shall be reported in units of parts per billion by volume (ppbv) and/or micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

The following are the required deliverables for each sample analyzed by the laboratory:

- The results of each analysis in correct units with the SDL, MQL, and SQL for each analyte;
- Dates of sample collection, receipt, preparation, and analysis;
- Copy of the COC and sample receipt forms signed by the sample custodian;
- Complete method references for sample cleanup, preparation, and analysis;
- A laboratory review checklist and exception report summarizing any QA/QC non-conformances and the corrective action taken plus any analytical limitations or anomalies that resulted in sample dilution;
- A list relating laboratory identification (ID) to sample ID and field samples to QC samples;
- The laboratory National Environmental Laboratory Accreditation Conference (NELAC) accreditation number and annotation for any non-accredited method used for the samples; and
- Signature of the Laboratory Project Manager or Laboratory QA Manager

The list below describes the information to be provided for analysis of metals; as applicable:

- Evaluation of holding time, sample preservation, and percent solids;
- Results of initial and continuing calibration verification;
- Results of blank analyses including preparation and calibration;
- Results of laboratory duplicates and spike duplicates, expected values, control limits, and percent recoveries;
- Results of MS/MSD, unspiked sample ID, control limits, expected value, RPD, and percent recoveries;
- Results of post digestion spike samples, expected value, control limits, and percent recoveries;
- Results for LCS, expected value, control limits, and percent recoveries;
- Results for internal standards (inductively coupled plasma/mass spectrometry [ICP/MS] only); and
- Results for MDL check samples.

The list below describes the information to be provided for analysis of VOCs and SVOCs by gas chromatography/mass spectroscopy (GC/MS), as applicable:

- Evaluation of holding time, sample preservation, and percent solids;
- Results of initial and continuing calibration including the relative response factor (RRF) and the relative standard deviation (RSD) or correlation coefficient (r) for each analyte;
- Results of blank analyses;
- Results of surrogates spikes, the expected value, control limits, and percent recoveries;
- Results of MS/MSD, control limits, expected value, RPD, and percent recoveries;
- Results for LCS, expected value, control limits, and percent recoveries;
- Results of internal standards; and
- Results for MDL check samples.

The list below describes the information to be provided for analysis of herbicides, pesticides, and TPH by GC, as applicable:

- Evaluation of holding time, sample preservation, and percent solids;
- Results of initial and continuing calibration including the RRF and the RSD or r for each analyte;
- Results of blank analyses;
- Results of surrogates spikes, the expected value, control limits, and percent recoveries;
- Results of MS/MSD, control limits, expected value, RPD, and percent recoveries;
- Results for LCS, expected value, control limits, and percent recoveries;
- Results for endrin/DDT breakdown evaluation (pesticides only); and
- Results for MDL check samples.

In addition, if supporting data are requested, the report format will include the following:

- ICP interference check sample analysis;
- ICP serial dilution analysis;
- Results of bromofluorobenzene or decafluorotriphenylphosphine GC/MS tuning;
- Raw data for sample results and laboratory QC samples including labeled (and dated) chromatograms/spectra of sample results and laboratory QC checks; and

- Copies of run logs and extraction logs.

The laboratory will submit the analytical results to the RI/FS Manager or Field Investigation Manager as electronic data deliverables (EDDs) in a spreadsheet format and as a final data report in electronic format (i.e., Portable Document Format (PDF)). Format requirements for the laboratory EDD are given in Table 20.

2.6.5 Data Archiving and Retrieval

2.6.5.1 *Project Records*

In general, all records must be retained for a period of 10 years following commencement of construction and of any remedial action which is selected following completion of the RI/FS, per Section XIV, Paragraph 63 of the RI/FS AOC. A final project file will be developed for the RI/FS data including the following items: project plans and reports; QA audit reports, corrective action reports and data validation checklists; field operation records including field notes and logbooks, signed COC forms, corrective action reports, and training/certification records; final laboratory reports; and any other pertinent documents.

These items will be stored at PBW's Victoria, Texas office and access limited to project personnel. The project file will be maintained at this location until the conclusion of the project. Electronic data will be archived electronically and will be backed up regularly as part of PBW's automatic internet based file server backup procedure. Where printed as part of the paper data report package, data will also be archived in paper form. Contents of the project file will be offered to U.S. EPA Region VI 90-days prior to disposal. The RI/FS Manager will serve as the file custodian for the RI/FS.

2.6.5.2 *Laboratory Records*

Copies of final reports and COC forms will be kept by the laboratory for a period of three years. Raw data and bench data files will be kept by the laboratory for a period of three years. Laboratory notebooks, data forms, COC forms, and any ancillary documentation pertinent to the project will be stored in a secured storage area. Analytical data stored in a LIMS will be maintained under a high level of data security by the use of passwords and file access/lock codes.

3.0 DATA GENERATION AND ACQUISITION

3.1 SAMPLING PROCESS DESIGN

Sampling is the selection of a portion of a larger target population, universe, or body, with the characteristics of that sample being inferred as applicable to the target population. The purpose of the sampling design for the RI/FS is to define in detail the sampling and data gathering methods needed to obtain data that are representative of conditions at AOI-1 and that will be used to evaluate the nature and extent of COPCs and provide input to the risk assessment.

3.1.1 Sampling Rationale and Design

The overall rationale for the design of the RI/FS program is discussed in the RI/FS WP Section 4.2. Design rationale and objectives for specific tasks, including data generation subtasks, are provided by task in Section 5 of the RI/FS WP. The proposed analytical suite for each sample is based on historical USOR Property operations information and existing data. Rationale for the selection of specific sampling locations is included in RI/FS WP Appendix D. Table 2 of the FSP presents the Sample Design Collection Worksheet and details the planned sample locations and frequencies, including the type and total number of sample types/matrices. Proposed locations for RI/FS samples are shown on Figure 9 of the RI/FS WP and Figure 4 of the FSP. Section 5.2 of the FSP describes how sample locations will be identified and procedures to take if a location is inaccessible.

3.1.2 Sampling Schedule

Investigation activities will initially focus on on-property soil, groundwater, surface water, and sediment, proceeding to off-property soil and off-property groundwater (Iteration 1). If needed, off-property surface water, sediment, and fish/shellfish will be investigated in Iterations 2 and 3, respectively. A preliminary RI/FS schedule is shown on Figure 10 of the RI/FS WP.

3.1.3 Critical and Non-Critical Samples

Soil physical properties, natural attenuation parameters, and groundwater classification parameters are considered supporting data and are not collected for use in meeting the primary objectives of the project (nature and extent of impacts, and risk assessment). Soil, groundwater, surface water, sediment, and fish/shellfish to be analyzed for COPCs are designated as critical samples. Sample integrity is essential for the activities covered by this QAPP, such that data gaps are not created in the record, and the end user requirements of the data are met.

3.1.4 Sampling Variability

All methods for sample collection are based on standard methods and accepted practices. Should any non-standard field analytical methods be proposed, a Workplan Refinement Notice (WRN) to the RI/FS WP or FSP will be prepared and submitted to EPA for review and approval prior to use.

3.2 **SAMPLING METHODS**

Field sampling procedures employed during the RI/FS will be consistent throughout the project, thus providing data representative of site conditions. Procedures for installation of soil borings/monitoring wells and all aspects of collection, preservation, and transport of groundwater, surface water, soil, and vapor samples, including equipment lists and decontamination are described in FSP Section 5 and the SOPs provided in Appendix A of the FSP. Soil sampling procedures, including those related to homogenizing and splitting samples, are described in more detail in PBW SOP No. 5 (Soil and Sediment Sampling for Chemical Analysis). The applicability of, and procedures for, filtering water samples collected for analysis are described in PBW SOP No. 10 (Water Quality Sampling).

3.2.1 Sample Volume, Containers, and Preservation

The sample volume, container, and preservation requirements for the specific analytical methods are listed on Tables 18 and 19 for aqueous and solid samples, respectively.

3.2.2 Response to Sampling System Failure

Failure of a sampling system shall be reported to the Field Investigation Manager and then to the RI/FS Manager. The RI/FS Manager is responsible for corrective actions as described in Section 4.1.2.

3.3 **SAMPLE HANDLING AND CUSTODY**

Sample handling procedures, including sample labeling requirements and an example sample label, are described in Section 6.1 of the FSP. The sample identification system to be used for uniquely identifying each sample location and sample is described in Section 4 of the FSP. Sample preservation and holding time requirements are listed on Tables 18 and 19 for aqueous and solid samples, respectively. A temperature blank will be included in each sample cooler to ensure that the temperature of the contents meets the preservation requirements upon receipt at the laboratory.

Sample custody procedures will be adhered to for handling environmental samples and associated records during sample collection, shipment, transfer, and storage. A sample is considered to be under a person's custody if:

- It is in that person's possession.
- It is in that person's view, after being in that person's possession.
- It was in that person's possession and was locked up by them to mitigate tampering.
- It has been placed in a designated secure area by that person.

When completing written records to document sample custody, errors will be corrected by drawing a single line through the error, re-entering the correct information, and initialing and dating the correction.

3.3.1 Field Custody Procedures

Sample containers provided by the laboratory for this project will be shipped by common carrier or other suitable method in sealed coolers to a location designated by the RI/FS Manager. Containers will be considered in the custody of the laboratory until received by PBW or a designated representative. Upon receipt, the shipment will be checked to verify that all containers are intact. The containers will be maintained in the custody of the receiver in a clean, secure area until used for sample collection.

A triplicate COC form will be used to document sample handling during transfer from the field to the laboratory and among contractors. The form is also used to specify the analyses to be performed and should contain the following information:

- Site name and address or location;
- Laboratory name and address or location;
- Name of sampler responsible for sample submittal;
- Identification of samples that accompany the form including field ID number;
- Date/time collected;
- Sample matrix type;
- Number of containers;
- Sample container type, volume, preservative;
- Parameters/methods of interest;
- Turnaround requested (e.g., standard or rush);
- Data level requirement;
- Comments about sample conditions;
- Signature of person relinquishing custody and signature of person accepting custody, plus date and time; and
- Identification of common carrier.

The Field Investigation Manager is responsible for reviewing field forms for correctness and completeness. An example COC record and procedures for completing the form are included in the RI/FS FSP Section 6.1.2 and as PBW SOP No. 6 (Sample Custody, Packaging and Shipment) in Appendix A of the FSP.

3.3.1.1 Response to Failures in Field Custody Procedures

All failures associated with field custody procedures are immediately reported to the person who originally signed the COC form, typically the Field Investigation Manager. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The RI/FS Manager or Field Investigation Manager, in consultation with the QA Manager, will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data quality will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the USOR Project Coordinator. The RI/FS Manager is responsible for correction actions, as described in Section 4.1.2.

3.3.2 Laboratory Custody Procedures

For the RI/FS, standard laboratory custody procedures will be implemented. These procedures are applicable to all laboratories handling samples for this project. Samples received and logged into the laboratory will remain in the custody of laboratory personnel until disposal.

3.3.2.1 Sample Receipt and Inspection

Upon arrival at the laboratory, samples will immediately be taken to the sample receiving area and logged into the laboratory sample registry in which the date and time of sample receipt will be recorded. Information on the COC form will be checked and the sample custodian will sign the form to document receipt of the samples. The custody forms will be reviewed for completeness and the information on the form will be checked against the bottle labels.

Sample containers will be inspected for integrity and agreement with the custody form and any issues documented on the custody form or associated document (i.e., a sample receipt report or similar document). Information to be noted includes: name of person inspecting cooler, sample cooler temperature, evidence of preservation, physical condition of sample container, and air bill number. If any sample integrity or sample ID problems or discrepancies are found, the Field Investigation Manager or RI/FS Manager will be notified immediately. A custody form addendum or sample receipt report may be used to document the corrective

actions used to address any discrepancies. If an addendum is not used, corrective actions used to correct discrepancies must be recorded directly on the custody form.

The sample custodian will also inspect sample containers for leakage. A sample container with integrity issues may not be acceptable for analysis. Samples in plastic containers appearing to bulge or evolve gas will be treated with caution because toxic fumes or material of an explosive nature may be present. Discrepancies between information on sample labels and information provided on the chain-of-custody form or broken/altered samples will be resolved with PBW and the Laboratory Project Manager before the sample is assigned for analysis.

The completed, signed COC and sample receipt report will be emailed to the Field Investigation Manager within 24 hours of sample receipt. A completed, signed custody form and any addenda will be sent by the laboratory to the RI/FS Manager with the final laboratory report.

3.3.2.2 Internal Tracking and Numbering

The sample custodian or designee will have responsibility for maintaining sample receipt logbooks, assigning a project log number to the samples, signing the COC form, reporting inconsistencies to the Laboratory Project Manager, and distributing samples to the laboratory sections in accordance with applicable analytical procedures. The laboratory section sample custodian is responsible for ensuring that samples are placed in storage, for monitoring conditions in sample storage areas, and maintaining records for COC within the laboratory. The Laboratory Project Manager or designee is responsible for initiating paperwork for report files and analytical worksheets and logging samples into the LIMS, if applicable.

Each sample will be assigned a unique laboratory sample number at the time of log-in to facilitate tracking of samples, extracts, and digests during analysis. The laboratory sample number will be recorded on the COC form, and logged into the computerized LIMS, if applicable. Any accompanying paper work will be placed in a project file until the order is completed. The laboratory project identification number will be recorded on all containers submitted in the project shipment.

After initiating a new log-in number, the Laboratory Project Manager or designee will enter electronically or otherwise record relevant sample information, as follows:

- Laboratory sample number;
- Client project identification;
- Date received/date due;

- Matrix/sample identification;
- Date and time of sample collection;
- Storage location/container size/container type/preservative;
- Analyses required; and
- Problems/special instructions.

After assignment of the project identification number, samples will be labeled to identify the project number and sample designation. The samples will then be dispersed to the appropriate sample storage area.

For samples requiring pH adjustment, the departmental custodian will log the samples into the departmental sample registry, check and document pH on an in-lab form and ensure that appropriate pH adjustments are made. If a sample requires pH adjustment in the laboratory, this should be noted in the laboratory report and the sample results should be qualified to indicate that pH adjustment was conducted.

3.3.2.3 Laboratory Storage Areas

Samples and extracts will be stored in uniquely identified refrigerated storage units located in secure areas of the laboratory. Samples are logged into the various department storage areas prior to preparation, analysis, or disposal. Samples to be analyzed for VOCs will be segregated from other samples. Samples will be stored separately from standards. Sample storage temperature logs will be maintained for storage refrigerators or freezers to assure maintenance of proper sample temperature throughout laboratory custody.

On a daily basis, the sample custodian or appropriate designee will measure and record the temperature of each refrigerator or freezer used for sample storage. For samples to be analyzed for organics, the acceptable range for sample storage is $\leq 6^{\circ}\text{C}$. The sample custodian will notify the Laboratory Project Manager of any refrigerator temperature problem which cannot be corrected by simple thermostat adjustment.

3.3.2.4 Laboratory Custody Transfers

Under normal circumstances, samples will be analyzed at the specific laboratory determined prior to the initiation of the field investigation. Samples will not be transferred to another laboratory without permission of the RI/FS Manager. When samples are transferred to another laboratory, a COC form will be initiated at the time of shipping by the sample custodian. A completed and signed copy of the custody form will be sent to the receiving laboratory and upon arrival at the receiving laboratory, laboratory custody procedures described above will be followed.

3.4 ANALYTICAL METHODS

3.4.1 Field Measurements

Field personnel will perform the field measurements such as screening of organic vapors in soil and measuring groundwater properties using the standard operating procedures specified on Table 12. Specific equipment and procedures to be used during the field screening of soil samples for organic vapors using an OVM are presented in PBW SOP No. 3 (Field Organic Vapor Screening Methodology for Soil Samples). Water quality parameters to be measured in the field using field equipment are described in PBW SOP No. 10 (Water Quality Sampling). Field SOPs are included in Appendix A of the FSP.

3.4.2 Laboratory Analyses

3.4.2.1 *Fate and Transport Analyses*

The laboratory will analyze fate and transport parameters, groundwater classification parameters, parameters required for adjustment of ecological benchmarks, etc. in accordance with EPA or other standard reference methods as specified on Table 13. Minimum laboratory quality control requirements are shown on Table 17. Internal laboratory procedures may require additional QA/QC activities. Laboratory deliverables are specified in Section 2.6.4.1. Standard turnaround time is three weeks. Rush turnaround (one week) may be requested by the RI/FS Manager as needed to meet the project objectives and schedule.

3.4.2.2 *COPC Analyses*

The laboratory will analyze samples of various media for metals, pesticides/herbicides, VOCs, SVOCs, and TPH in accordance with EPA SW-846 (EPA, 1986) or TCEQ methods. Tables 2 through 11 provide the selected analytical methodology and analyte lists along with the MQLs and PSVs for the various media to be assessed (groundwater/surface water, soil/sediment). Laboratory MQLs should be below the PSVs for a given analyte. If it is not possible to achieve an MQL below the screening criteria PSVs, then the standard available method with the lowest possible MQL should be used for that analyte. Minimum laboratory quality control requirements are shown on Tables 14 through 16. Internal laboratory procedures may require additional QA/QC. Laboratory deliverables are specified in Section 2.6.4.2. Standard turnaround time is three weeks. Rush turnaround (one week) may be requested by the RI/FS Manager as needed to meet the project objectives and schedule. The analytical laboratory(ies) chosen for the RI/FS will be able to perform the specified analyses per these requirements, including those regarding method sensitivity.

3.4.2.3 Requirements for Sample Disposal

Unused samples, digests, and extracts will be appropriately stored by the laboratory until disposal is authorized by the RI/FS Manager, typically 60-days after the final laboratory report is sent. Following approval, materials will be disposed of in accordance with federal, state, and local regulations.

3.4.3 Response to Analytical System Failure

In many cases, the field technician or laboratory analyst will be able to correct analytical problems. If the problem is resolved by the field technician or laboratory analyst, he/she will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the Field Investigation Manager or Laboratory QA Manager, who will make the determination and notify the QA Manager. If the analytical system failures may compromise the sample results, the resulting data will not be reported. The nature and disposition of the problem is reported on the data report, which is sent to the RI/FS Manager. Corrective actions are further detailed in Section 4.1.2.

3.5 QUALITY CONTROL

3.5.1 Field QC Checks

3.5.1.1 Level of Field Quality Control Effort

Minimum requirements for collection of field quality control samples are provided on Table 14.

Requirements are given for samples collected for COPC analysis, while field QC samples are not proposed for fate and transport samples.

Field precision will be assessed by collecting and analyzing field duplicate samples at a rate of one duplicate per 10 investigative samples. Matrix effects on the sample analysis will be assessed through the collection and analysis of MS/MSD at a rate of one pair per 20 investigative samples.

Sampling accuracy will be assessed by collecting and analyzing trip and equipment blanks. One equipment rinsate blank will be collected each day that samples are collected with re-usable sample collection devices. If different types of re-usable sample collection devices are used, an equipment rinsate blank is required for each type of device. One trip blank will be submitted for laboratory analysis each day that soil or water samples are submitted for VOC analyses.

3.5.1.2 *Field Duplicates*

Field duplicate samples will be defined as those samples collected simultaneously from the same source under identical conditions into separate but identical containers, and preserved, stored, transported and analyzed in the same manner. Thus, to prepare a field duplicate, an aliquot will be collected from a sample source (i.e., soil or water), and divided equally into two separate but identical sample containers. Each field duplicate will be identically preserved, stored, transported and analyzed. Field duplicates will be analyzed by the same laboratory analyzing investigative samples. Precision of duplicate results is expressed as RPD, which is calculated as follows:

$$\text{RPD} = \frac{\text{Absolute Value (primary sample result} - \text{duplicate sample result)}}{\text{average of primary and duplicate sample result}} \times 100$$

3.5.1.3 *Equipment Rinsate Blanks*

Equipment rinsate blanks will be collected to verify the efficacy of cleaning procedures for sampling equipment. After use and decontamination, rinsate blanks will be collected by i) placing organic-free/de-ionized, or distilled water in contact with the field sampling apparatus (e.g., coring device, spoon, bowl, bailer, or pump tubing); ii) collecting the rinsate in method-specified sample containers with appropriate preservatives; and iii) analyzing for the COPCs. Equipment rinsate blanks will be appropriately labeled and documented in field records. Blanks will be stored, transported, and analyzed with associated samples. No equipment rinsate blanks will be collected or analyzed if dedicated or disposable (one-time use) sampling equipment is used.

3.5.1.4 *Trip Blanks*

The effectiveness of sample handling techniques will be evaluated by submitting preserved trip blank samples for laboratory analysis. Trip blanks will consist of a pair of 40-mL volatile organic analysis (VOA) vials with TeflonTM lined septa, filled in the laboratory (or organization providing the sample containers) with laboratory-grade (organic-free/de-ionized or distilled) water. The unopened trip blanks will accompany the VOA sample bottles to the sampling site and back to the laboratory in the same shipping cooler. Proper labeling and documentation will be completed for trip blanks.

3.5.2 Laboratory QC Checks

3.5.2.1 *Level of Laboratory Quality Control Effort*

Minimum requirements for laboratory QC samples are provided on Tables 14 and 16. Detailed requirements are given for samples for COPC analysis, while limited requirements are proposed for fate and transport analyses. Internal laboratory procedures may require additional QA/QC activities.

Results from method blank samples for all constituents analyzed will be reviewed to assess potential sources of contamination associated with laboratory procedures. Laboratory method blanks will be prepared and analyzed at a frequency of one per sample batch (i.e., each group of samples prepared and analyzed as a group, not to exceed 20 samples per group or every 12 hours [VOCs only]).

Results from laboratory duplicate samples will be reviewed to assess laboratory precision. Laboratory duplicates will be analyzed at a frequency of one per sample batch (i.e., each group of samples prepared and analyzed as a group, not to exceed 20 samples per group). This requirement can be satisfied by the analysis of a MS/MSD pair.

LCS results for all constituents analyzed and routinely spiked by the laboratory will be reviewed to assess laboratory performance and accuracy. LCS will be analyzed at a frequency of one per sample batch (i.e., each group of samples prepared and analyzed as a group, not to exceed 20 samples per group) or every 12 hours (VOCs only).

Results for MS/MSD pairs will be reviewed to evaluate the effect of the sample matrix on the sample preparation and measurement methodology. For samples analyzed for COPCs, MS/MSD sets will be analyzed at a frequency of one per sample batch (i.e., each group of samples prepared and analyzed as a group, not to exceed 20 samples per group).

Accuracy for the analysis of VOCs, SVOCs, pesticides/herbicides, and TPH will be assessed by evaluating the recoveries of surrogate compounds spiked into all samples. Additionally, internal standards will be spiked into all samples analyzed for VOCs, SVOCs, and metals analysis (ICP/MS only). QC criteria for internal standards are the method specified values.

3.5.2.2 *Laboratory Duplicates*

Laboratory duplicate analysis is performed as a measurement of precision on the analytical process.

Laboratory duplicates are independently repeated measurements of the same sample, which are performed by the same analyst and under the same conditions. The sample is split in the laboratory and each fraction is carried through all stages of preparation and analysis. The calculation for RPD is performed from the two sample results as follows:

$$\text{RPD} = \frac{\text{Absolute Value (primary sample result - duplicate sample result)}}{\text{average of primary and duplicate sample result}} \times 100$$

3.5.2.3 *Laboratory Control Samples and Laboratory Control Sample Duplicates*

The LCS is an aliquot of a solid or aqueous certified reference material containing a known amount of each target analyte being measured. The LCS is treated like a field sample from the beginning of the procedure and is carried through the entire measurement process. The amount of the spike should be at a level less than or equal to the midpoint of the calibration curve for each analyte. The percent recovery of the target analytes in the LCS assists in determining whether the procedure is in control. It is further used to evaluate the accuracy and bias of all or a portion of the measurement process. The LCS recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{measured amount}}{\text{known amount}} \times 100$$

A second spike (prepared and analyzed separately) is called the LCS duplicate. This evaluates the precision associated with the procedure and the analyst performing the procedure and is calculated as RPD as described above.

3.5.2.4 *Matrix Spikes and Matrix Spike Duplicates*

MS samples are prepared by adding a known amount of each target analyte to a known amount of sample. The MS is added at the beginning of the procedure and is carried through the entire measurement process. The sample itself (without a MS) is also carried through the analytical process. Because the MS samples are prepared and analyzed at the same time as the sample, only a reasonable estimate of the spike level can be made. Samples collected in field areas that are expected to have high concentrations will be identified for the laboratory, and corresponding spike levels can be used. The amount of the spike should be at least four times the amount in the unspiked sample.

The spike recovery measures the effects of interferences caused by the sample matrix in the analytical process. The MS recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{spiked sample result} - \text{sample result}}{\text{theoretical spike concentration}} \times 100$$

A second spike (prepared and analyzed separately) is called the MSD. This evaluates the precision associated with the procedure and the analyst performing the procedure and is calculated as RPD as described above.

The MS/MSD is used to document the bias of a method due to sample matrix not to control the analytical process; thus laboratory corrective action is not instituted based on MS/MSD results alone.

3.5.3 Response to Failures in Quality Control

Qualified data are evaluated by the RI/FS Manager, in consultation with the QA Manager. In that differences in field duplicate sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the RI/FS Manager and QA Manager will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Field duplicate excursions will be noted. Equipment blanks and trip blanks will be used to qualify data and may be used to invalidate the sample results, especially in cases where high blanks may be indicative of contamination that causes a result to exceed the standard. Corrective action will involve identification of the cause of the failure where possible. Response actions may include re-analysis of questionable samples. In some cases, a sample location may have to be resampled to achieve project goals. Corrective actions are further detailed in Section 4.1.2.

Laboratory measurement quality control failures are evaluated by the Laboratory Project Manager and findings reported to the RI/FS Manager. Specific instances requiring laboratory corrective action are listed in Section 4.1.2.2.

3.6 **INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE**

3.6.1 Field Instrument/Equipment Testing, Inspection, and Maintenance

A list of possible field equipment to be used during the RI/FS is provided in FSP Section 5.1. Equipment will be inspected visually and functionally prior to each day's use by testing the equipment in accordance with the acceptance criteria in the operator's manual for each piece of equipment. Moving parts, seals, fasteners, and switches will be inspected and adjusted or replaced as necessary. Cables, tapes, and attachments will be inspected for damage or kinks. An inventory of spare parts will be available in order to complete routine maintenance tasks as identified in the operator's manuals. Critical spare parts such as batteries will be kept

on-site to reduce downtime. Equipment cleaning will be performed in accordance with PBW SOP No. 13 (Equipment Decontamination), which is included in Appendix A of the FSP. The Field Investigation Manager is responsible for ensuring proper functioning of field equipment.

When routine maintenance procedures do not correct a problem with instrumentation, backup equipment will be used. Backup instruments and equipment will be available on-site or within one day shipment to avoid delays in the field schedule. Backup equipment and any equipment returned to service after repair will be visually and functionally inspected prior to use as described above. Corrective action will involve identification of the cause of the failure where possible. Response actions will include re-analysis of questionable samples. The RI/FS Manager is responsible for implementing and documenting the effectiveness of corrective actions involving field equipment.

3.6.2 Laboratory Instrument/Equipment Testing, Inspection, and Maintenance

The equipment testing and maintenance procedures, schedules and acceptance criteria for laboratory tools, gauges and instruments will be documented in the laboratory QA Manuals. Testing and maintenance records are maintained by the Laboratory QA Manager and are available for inspection. Instruments requiring daily or in-use testing may include, but are not limited to: water baths, ovens, autoclaves, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained or are available through a preferred vendor status to prevent downtime. Maintenance records are available for inspection.

When routine maintenance procedures do not correct a problem with instrumentation, outside repair services will be available on a next day basis. Repaired instruments and equipment will be tested and inspected prior to return to service as described above. Corrective action will involve identification of the cause of the failure where possible. Response actions will include re-analysis of questionable samples. The laboratory QA Manager is responsible for implementing and documenting the effectiveness of corrective actions involving laboratory equipment.

3.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

3.7.1 Field Instrument/Equipment Calibration

Calibration of field equipment will be performed in accordance with the manufacturer's recommendations, including acceptance criteria and frequencies, in the operator's manuals. Specific details for OVMs and water quality meters, which will be used in the RI/FS program, are given in PBW SOP No. 3 (Field Organic Vapor Screening Methodology for Soil Samples) and in PBW SOP No. 9 (Water Quality Sampling), respectively.

These SOPs are included in Appendix A of the FSP. When possible, equipment will be calibrated by the equipment supplier prior to use. If calibration of equipment will be required during the RI/FS, the equipment supplier will provide the calibration instructions and necessary standards and/or equipment. Standards and buffers will be checked for expiration date and replaced if necessary. Successful calibration will be conducted at least daily prior to use and documented by field personnel. Severe conditions such as high humidity or low ambient temperatures may necessitate more frequent calibration. The Field Investigation Manager is responsible for ensuring field equipment is properly calibrated.

Field instruments that fail two consecutive calibrations will be tagged as “nonfunctional” and returned to the manufacturer/provider for repair or replacement. Repaired equipment will be calibrated prior to return to service as described above. Corrective action will involve identification of the cause of the failure where possible. Response actions will include re-analysis of questionable samples. The RI/FS Manager is responsible for implementing and documenting corrective actions involving calibration of field equipment

3.7.2 Laboratory Instrument/Equipment Calibration

Detailed laboratory calibration procedures, schedules and acceptance criteria are provided within the specifications and SOPs in the laboratory QA Manuals. The Laboratory QA Manager identifies tools, gauges, instruments, and other sampling, measuring, and testing equipment used for data collection activities affecting quality that must be controlled and, at specified periods, must be calibrated to maintain performance within specified limits. Calibration records are maintained and are available for inspection. Equipment requiring periodic calibrations includes, but is not limited to, thermometers, pH meters, balances and analytical instruments.

Analytical instrument calibration protocols will meet or exceed the requirements specified in the EPA, TCEQ, or American Society for Testing and Materials (ASTM) reference method employed for sample analysis. Initial instrument calibration curves will be generated, verified, and routinely monitored during instrumental analyses, as required by specific SOPs. Samples will not be analyzed until a successful calibration is performed.

Records of calibration, repairs, or replacement will be maintained by the designated laboratory personnel performing quality control activities and filed at the location where the work is performed. Instruments that fail calibration requirements may require routine maintenance or a service call. Repaired instruments will be calibrated prior to return to service. Corrective action will involve identification of the cause of the failure

where possible. Response actions will include re-analysis of questionable samples. The laboratory QA Manager is responsible for implementing and documenting corrective actions involving laboratory equipment

3.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

New batches of field supplies are inspected and tested, if appropriate, before use to ensure that they are adequate and free of contaminants. Acceptance criteria are detailed in the manufacturer's documentation for the product. The Field Investigation Manager is responsible for ensuring that field supplies meet the criteria. The laboratory QA Manuals will provide details on acceptance requirements, procurement procedures, and responsible personnel for laboratory supplies and consumables. The procurement of purchased items and services that directly affect the quality of environmental projects shall be planned and controlled to ensure that the quality of the items and services is known, documented, and meets the QAPP requirements and acceptance criteria.

3.8.1 Traceability of Standards

Standards used for calibration of instrumentation used in analyzing RI/FS samples will be NIST traceable, EPA A2LA certified, or obtained from another appropriate source. Records will be maintained to verify the traceability of standards used and will include pertinent information such as the date, analyst, compound, purity, dilution volume, etc., as appropriate. Additional details concerning the preparation and use of standards are documented in the laboratory QA manuals.

3.8.2 Storage of Standards

As soon as practical after receipt, standards will be transferred to a designated storage area in the laboratory. Volatile standards will be stored in a freezer; and other commercially purchased stock standards are stored at $\leq 6^{\circ}\text{C}$, in a freezer, or at room temperature, as appropriate. Standards will be stored separately from samples. Certification sheets will be kept on file within each lab division and stored for future reference.

3.9 DATA MANAGEMENT

Data management provides a process for tracing the path of the data from their generation in the field or laboratory to their final use or storage. The following elements are included in this process: recording, reduction, transformation, transmittal, validation, analysis, and storage and retrieval.

3.9.1 Data Recording

Sample collection will be documented and tracked using field log forms, field logbook entries, and COC Records. Field personnel will complete these forms, which then will be reviewed for correctness and completeness by the Field Investigation Manager. Copies of these forms will be maintained in the project files. Examples of field forms and procedures for completing each are included in the SOPs in Appendix A of the FSP.

3.9.2 Data Handling

Field measurements will be taken directly from direct reading instruments, such as water quality and organic vapor meters, and will require no data reduction; therefore, data from these instruments will be recorded on the appropriate field form immediately after measurements are taken.

To convert laboratory raw data from instrument reading to reportable results, raw data will be reduced to reportable values by instrument hardware and software or by other manual procedures described in the applicable reference method. Reduction of laboratory measurements and laboratory reporting of analytical parameters will be conducted in accordance with the procedures specified for each EPA, TCEQ, or ASTM analytical method. Detailed laboratory data reduction procedures are provided within the specifications and SOPs in the laboratory QA Manuals.

The Field Investigation Manager will be responsible for assuring that field data are entered onto the appropriate field data forms, and will report any problems to the RI/FS Manager. Field Investigation Managers will submit the complete field data forms to the RI/FS Manager for review and error checking.

Field Investigation Managers will also ensure that samples collected in the field are submitted to the laboratory according to the methods outlined in this QAPP or the FSP. The laboratory will submit the analytical results to the RI/FS Manager or Field Investigation Manager as EDDs in a spreadsheet format and as a final data report in electronic format (i.e., PDF).

Once reviewed by the RI/FS Manager or Field Investigation Manager for obvious transcription or reporting errors, the final laboratory report will be transmitted and ready for validation by the QA Manager. Following data validation, any data qualifiers added to data during the validation process will be imported into the project database. Entry or upload of EDDs and data qualifiers into the project database will be completed by a designee of the RI/FS Manager. The data and qualifiers will be initially verified by the individual entering the data. Upon completion of the initial verification step, a data report will be generated and verified by the

US Oil Recovery Superfund Site

RI/FS Manager against the original data. Only final versions of electronic data will be entered into the database. Electronic data will be verified before and after incorporation into the database against the reports that accompany the data.

Qualified data will be included with the data packages during all subsequent data transmittal processes. The final data validation checklists will be included with the data in the Remedial Investigation Report. In addition, the Remedial Investigation Report will summarize the overall completeness for the project and any significant data qualifications.

Field forms and laboratory data will be organized and stored by sample location allowing for easy access if needed. Data can be transferred electronically either on compact disc, tape, or as an email attachment.

3.9.3 Data Verification and Validation

Data verification and validation is addressed in Section 5 of this document. A summary of the process is presented on the checklists included in PBW SOP No. 16 (Data Verification and Validation) (Appendix A).

3.9.4 Data Analysis

Data analysis will be conducted as described in RI/FS Work Plan Section 8.5. Only validated data will be used for data analysis. Software applications used to analyze the data will include commercially available basic software such as Microsoft Excel® and Microsoft Access®, and more specialized commercial software such as AQTESOLV (for interpreting slug test data). Proprietary or non-industry standard software is not proposed for use as part of this project. Equipment and hardware utilized for data analysis will consist of commercially available computer equipment and software, use of proprietary or specialized equipment is not expected to be required for data analysis. Data analysis results for each activity will be presented in the RI Report.

3.9.5 Data Archiving and Retrieval

The RI/FS Manager is responsible for project data storage and retrieval. In general, all records and data must be retained for a period of 10 years following commencement of construction of any remedial action which is selected following completion of the RI/FS, per Section XIV, Paragraph 55 of the Settlement Agreement. Specific data storage requirements are given in Section 2.6.5.

4.0 ASSESSMENT AND OVERSIGHT

4.1 ASSESSMENTS AND RESPONSE ACTIONS

4.1.1 Performance and System Audits

Performance and system audits will be conducted to verify that sampling and analysis are performed in accordance with applicable SOPs specified for field activities in Appendix A of the FSP and for laboratory activities. Outcomes of assessments will be reported to the Respondent's Project Coordinator, who will immediately notify the RI/FS Manager if corrective action is warranted as detailed in Section 4.1.2. The audits of field and laboratory activities include two independent components: internal and external audits.

4.1.1.1 Field Performance and System Audits

Internal audits of field activities, including sampling and field measurements, may be conducted as needed by the RI/FS Manager or a designated alternate. Additional team members or Respondent personnel may also be present during various phases of the audits. These audits will be conducted to evaluate performance, verify that procedures are followed, and correct deficiencies in the execution of field procedures. An internal field audit will be conducted around the beginning of the sample collection activities to verify that established procedures are being followed.

External field audits may be conducted by a third party such as the EPA Remedial Project Manager or a designated alternate. External field audits may be conducted at any time during the field operations. These audits may be scheduled or non-scheduled, and will be performed at the discretion of the EPA Remedial Project Manager and/or the Respondents' Project Coordinator.

To verify compliance with established procedures and implementation of appropriate QA procedures, field audits will involve the review and examination of the following: i) field measurement and sampling records, ii) instrument operation and calibration records, iii) sample collection documentation, iv) sample handling and packaging procedures, and v) COC procedures. If the first audit reveals substantive deficiencies, one or more follow-up audits will be conducted to verify that QA procedures are maintained throughout the RI/FS. Audit results will be reported to the RI/FS Manager and/or the Respondents' Project Coordinator within 30 days of completion.

4.1.1.2 Laboratory Performance and System Audits

Internal system and performance audits at the laboratory will be the responsibility of the Laboratory QA Manager. The internal laboratory quality system audits will follow the procedures in the laboratory's Quality Assurance Manual.

One or more external laboratory audits may be conducted by a third party such as the EPA Remedial Project Manager or a designated alternate. External laboratory audits may be conducted at the discretion of the EPA Remedial Project Manager and/or the Respondents' Project Coordinator. External lab audits can include, but not be limited to, review of laboratory analytical procedures, laboratory on-site audits, and/or submission of performance evaluation samples to the laboratory for analysis. The contract laboratory generating definitive data for COPCs will be accredited by the TCEQ through the NELAP program; TCEQ conducts regular audits of the accredited laboratories.

4.1.2 Corrective Action

Corrective action will be taken to identify, recommend, approve, and implement measures to remedy unacceptable procedures or out-of-control performances potentially affecting data quality. Corrective action can occur during field activities, laboratory analyses, and data verification and validation. Corrective actions may be required for non-conformance with procedures specified by the QAPP including those resulting from malfunction of sampling or analytical equipment or for changes in sampling network or frequency. Non-conformances include those instances of conducting activities outside the requirements of the QAPP (i.e., missing holding times or detecting blank contamination). Analytical and equipment problems may occur during sampling, sample handling, sample preparation, or laboratory analysis. Modifications in the sampling network may result from inaccessible locations or from inadvertent omissions in sample collection.

Non-conformance to quality control procedures specified in the QAPP will be identified, reported, and corrected. If the non-conformance is identified during sample collection or analysis, corrective action will be implemented immediately by the field technician or laboratory analyst. If the non-conformance is identified during an internal/external audit or third-party data validation, corrective action will be implemented after notification of the RI/FS Manager, and/or the Laboratory Project Manager. The Respondents' Project Coordinator will communicate the need for corrective action and the planned remedy to the EPA Remedial Project Manager.

4.1.2.1 Field Corrective Action

Corrective Action for Procedural Non-Conformances

The Field Investigation Manager and field technical staff will be responsible for reporting suspected technical or QA non-conformances, malfunctions or deficiencies to the RI/FS Manager. The RI/FS Manager will be responsible for ensuring that any necessary corrective actions are implemented. Non-conformances potentially affecting data quality will be brought to the attention of the Respondents and the EPA Remedial Project Manager as soon as practical. If appropriate, the RI/FS Manager will suspend additional work depending on the nature of the non-conforming activity until the corrective action is completed. The RI/FS Manager will ensure that corrective action for the non-conformance is completed by evaluating and controlling additional work on non-conforming items, determining appropriate action, and communicating with concerned persons via telephone, e-mail, or other medium.

In cases in which corrective actions of field procedures are required, a description of the nature of the problem, an evaluation of the cause, if known, and the action taken will be prepared by the RI/FS Manager or QA Manager and distributed to U.S. EPA.

4.1.2.2 Laboratory Corrective Action

Data packages prepared by the laboratory will include a discussion of the QC problems encountered and corrective actions taken. Corrective actions in the laboratory may occur prior to, during or after initial analyses. As such, the initial analyses must be performed quickly enough to allow time for reanalysis within the required holding time. If an out-of-control event or potential out-of-control event is noted in the laboratory, an investigation and corrective action will be taken appropriate to the analysis and the event. Laboratory corrective action may be required if any of the following occur:

- QC data are outside the warning or acceptable windows for precision and accuracy,
- Laboratory blanks contain target analytes above MQLs,
- Sample results are outside the instrument calibration range,
- Unusual changes in detection limits are noted,
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples, or
- Inquiries concerning data quality are received.

The following specific instances require laboratory corrective action:

- The laboratory method blanks contain target analytes above the MQL and any associated sample contains the analyte at a concentration less than five times that in the blank.

- The LCS recovery is less than 20% for any organic target analyte or 40% for any inorganic analyte.
- The surrogate recovery is less than 10% for any single surrogate.
- The MS recovery is less than 30% for any inorganic analyte.
- The internal standard area for a sample is less than 20% or greater than 200% of that in the daily midpoint standard for any single internal standard.

These numerical limits relate to requirements for internal laboratory QC corrective action (i.e., re-analysis, re-extraction, re-calibrating) for excursions and are not related to project QC objectives that require corrective action (i.e., re-analysis, data flags). The laboratory corrective action shall include reanalyzing (and extracting or digesting, as applicable) the affected samples and/or immediate notification of the project QA Manager.

The Laboratory QA Manager will be responsible for ensuring that corrective actions are taken, as appropriate, in the following situations:

- **Out-of-Control Criteria:** An out-of-control situation will exist when a blank, calibration standard, LCS, duplicate, MS, or MS/MSD fails to meet applicable quality control criteria. Corrective action procedures are often handled at the bench level by the analyst who reviews the preparation for possible errors, checks the instrument calibration, spike and calibration mixes, and instrument sensitivity. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor or Laboratory QA Manager for further investigation. Analyses completed during the out-of-control situation will be repeated after the out-of-control situation has been corrected. If matrix interference is indicated by out-of-control replicate analyses or matrix spike data, re-analysis of a sample batch may not be warranted. After resolution, the corrective action procedure will be documented and filed.
- **Warning Criteria:** Corrective measures will be implemented when one of the following two conditions occurs: i) quality assurance data for a blank, LCS, sample replicate, or MS exceed warning criteria, typically two standard deviations of applicable limits or ii) a trend or shift is observed for the reference standard. Provided other criteria are within applicable limits, samples need not be re-analyzed. If the situation occurs with the next sample batch, an out-of-control situation exists, and steps outlined above are taken.
- **Performance Audit:** If the laboratory fails to meet applicable requirements reviewed during a performance of systems audit, corrective action will be taken. The Laboratory Project Manager will notify the project QA Manager and the Respondents' Project Coordinator in the event of a corrective action taken in response to an audit. Applicable federal and state guidelines and requirements regarding response to audit findings will be observed by the laboratory.

4.1.2.3 *Corrective Action during Data Verification and Validation*

The QA Manager will review analytical reports generated by the laboratory prior to data use and filing. Upon receiving data verification or validation results, the RI/FS Manager will identify the need for corrective action and notify concerned persons by telephone, e-mail, or other appropriate medium. Specified corrective action will be developed to assure meeting required QA objectives. The RI/FS Manager and the Laboratory Project Managers will be responsible for implementing corrective actions in the field and laboratory, respectively.

Corrective action required may include re-sampling, collecting additional samples, or re-measurement of field

parameters. The laboratory may be required to repair or re-calibrate instrumentation, re-inject or re-analyze samples, or provide additional raw data. A description of the nature of the problem, an evaluation of the cause, if known, and the action taken will be prepared by the QA Manager or RI/FS Manager similar to that described for field corrective actions in Section 4.1.2.1. Deficiencies identified during the data verification and validation process will be included in the final project report.

4.2 REPORTS TO MANAGEMENT

4.2.1 Laboratory Data Report

Laboratory data reports contain the results of all sample analyses and specified QC measures as listed in Section 2.6.4, including but not limited to equipment and trip blanks, laboratory blanks, laboratory duplicates, LCS, calibration, and MS/MSD. This information is reviewed by the QA Manager and compared to the pre-specified acceptance criteria to determine acceptability of the data before forwarding to the RI/FS Manager.

4.2.2 Reports to Project Management

The Field Investigation Manager will report to the RI/FS Manager daily following each field monitoring event. As appropriate, a brief written report will be sent via e-mail to the RI/FS Manager that documents any problems, delays, or corrective actions that may be required or that may affect the subsequent sampling efforts. The report will also include a brief synopsis of the work conducted during the field monitoring event.

QA status reports will be provided in conjunction with the data verification report. As described in PBW SOP 16 (Data Verification and Validation), each data verification or validation report includes the checklist, a set summary, and a table of qualified laboratory results. The set summary includes an overall description of the data set (number of samples, tests performed, number of qualifiers applied with reason, etc.) and tracks completeness. A data verification or validation report will be completed for each set of data after the final data package is received from the laboratory. The QA Manager is responsible for generation of the data verification or validation reports, which will be sent to the RI/FS Manager.

5.0 DATA VALIDATION AND USABILITY

5.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements and the project objectives that are listed in Section 2.4. Data supported by appropriate QC results that meet the project objectives defined for this project will be considered acceptable without qualification. Data associated with QC results that do not meet the project objectives defined for this project will be assigned appropriate qualifiers reflecting the potential impact on data usability. Analytical data will be considered usable unless rejected during the review process.

5.2 VERIFICATION AND VALIDATION METHODS

5.2.1 Procedures Used to Verify and Review Field Data

The Field Investigation Manager is responsible for ensuring that field data are properly reviewed and verified for integrity by reviewing field equipment calibration records and verifying proper field procedures.

The field data package, including field records and measurements acquired by the sampling team personnel, will be reviewed by the QA Manager, as follows:

- Sampling records and COC forms will be reviewed to verify that samples, field duplicates, equipment rinsate blanks, and trip blanks were collected at the frequency specified in the QAPP and were properly prepared, preserved, and submitted to the laboratory.
- COC forms will be reviewed for proper completion, signatures of field personnel and the laboratory sample custodian, and dates.

5.2.2 Laboratory Procedures Used to Verify and Review Data

The Laboratory Project Manager is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity and indicates this by signing the data package narrative.

Data production will begin with the generation of data results by the analyst and continue through a multi-level review and validation process. Each step in the review process will be performed to assure the integrity and validity of the data generated by the laboratories. Data will be sequentially passed on to the peer review analyst of the staff chemist, the department supervisor, and finally the data entry personnel. The laboratory report will be reviewed by the Laboratory Project Manager and then will be certified by the Laboratory QA

Manager or designee. Each step in the review process will be performed to assure the integrity and validity of the data generated by the laboratories, as follows:

QC data (e.g., laboratory duplicates, LCS, surrogates, MS, and MSD) will be compared to laboratory acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the Laboratory QA Manager or designee for review. If approved, data will be logged into the project database. Unacceptable data will be appropriately qualified in the project report. Case narratives will be prepared to include information concerning data falling outside acceptance limits, and any other anomalous conditions encountered during sample analysis. Data will be issued after approval by the Laboratory QA Manager.

5.2.3 Third-Party Verification and Validation

The QA Manager will be responsible for ensuring that laboratory data are properly reviewed and verified, and submitted in the required format to the project database. The QA Manager is responsible for validating the laboratory data and documenting the review. Finally, the RI/FS Manager, with the concurrence of the QA Manager, is responsible for verifying that all data to be reported meet the objectives of the project and are suitable for reporting.

An independent data verification of 100% of the data for samples collected for COPC analysis will be conducted. Independent verification of the fate and transport analyses will not be required as these are supporting data and will not be used for nature and extent or risk assessment purposes. Data packages will receive a completion check to ensure that the deliverable requirements specified for the project in Section 2.6.4 have been satisfied.

To qualify data for use in the RI/FS, data verification will be performed on the quality control data associated with a particular sample. After a sample and associated QC data have been verified each analyte will be identified as one of the following:

- Acceptable for use without restriction (no qualifier);
- Qualified as an estimated value with a “J”;
- Qualified as not detected but estimated with a “UJ”; and
- Rejected as unusable for the intended use with an “R”.

Note that if one of the qualifiers listed above is assigned by the independent data validator, that qualifier will replace the flag assigned by the laboratory.

5.2.3.1 Data Verification for Metals

Metals data will be verified in accordance with the PBW SOP 16 (Data Verification and Validation, which is based on the procedures described in *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2014a), with reference to the numerical performance criteria in this QAPP. Verification of metals data will be performed in accordance with the procedures described in PBW SOP No. 16 and will involve a review of the following:

- Holding Times;
- Initial and Continuing Calibration Verification;
- Blanks;
- LCS recoveries;
- Laboratory Duplicate precision;
- MS/MSD recoveries and precision;
- Post Digestion Spike recoveries;
- Field Duplicate precision; and
- Overall Assessment of Data.

The specific elements of the process are presented in the data verification checklist included in PBW SOP No. 16 (Data Verification and Validation)

5.2.3.2 Data Review for Organic Compounds

VOC, SVOC, pesticide, herbicide, and TPH data will be verified in accordance with the PBW SOP No. 16 (Data Verification and Validation), which is based on the procedures described in *National Functional Guidelines for Superfund Organic Methods Data Review*, (EPA, 2014b), with reference to the numerical performance criteria in this QAPP. Verification of organic data will be performed in accordance with the procedures described in PBW SOP No. 16 and will involve a review of the following:

- Holding Times
- Initial Calibration
- Continuing Calibration
- Blanks
- LCS recoveries
- Surrogate recoveries
- MS/MSD recoveries and precision
- Internal Standards
- Field Duplicate precision
- Overall Assessment of Data

The specific elements of the data verification process are presented in the data verification checklist included in PBW SOP No. 16 (Data Verification and Validation).

5.2.3.3 Data Validation

An independent data validation of 10% of the data for samples collected for COPC analysis will be conducted. Independent validation of the fate and transport analyses will not be required as these are supporting data and will not be used for nature and extent or risk assessment purposes.

Metals data will be validated in accordance with the PBW SOP 16 (Data Verification and Validation, which is based on the procedures described in *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2014a), with reference to the numerical performance criteria in this QAPP. VOC, SVOC, pesticide, herbicide, and TPH data will be validated in accordance with the PBW SOP No. 16 (Data Verification and Validation), which is based on the procedures described in *National Functional Guidelines for Superfund Organic Methods Data Review*, (EPA, 2014b), with reference to the numerical performance criteria in this QAPP.

The specific elements of the data validation process are presented in the data validation checklist included in PBW SOP No. 16 (Data Verification and Validation).

5.3 RECONCILIATION WITH USER REQUIREMENTS

The data collected pursuant to this QAPP will be evaluated to see whether it supports the project objectives. Only data that has been verified or validated per the requirements in Section 5.2 will be used for the primary project objectives of determining the nature and extent of contamination and human health or ecological risk assessment. The process may result in the application of qualifier flags, which describe the degree to which individual values provide accurate and precise results. Data use for each type of qualifier is summarized as follows:

- Values that are assigned J flags (J, JH, or JL) are considered estimated results. Data assigned these flags indicate that they may not be accurate or precise within the limits specified in the QAPP but that the magnitude of the potential imprecision or inaccuracy is not great enough to reject the value for project data uses.
- Values assigned an R flag do not meet the accuracy or precision project requirements specified to provide quantitative data for the project data uses. The R flag indicates that serious deficiencies were encountered preventing the generation of usable data for the project objectives.
- Values are assigned U flags when the value is less than the SDL or to indicate that a low concentration of the analyte cannot be confirmed due to the presence of interference or the presence of the analyte in associated blanks. UJ flags may be applied to indicate values less than the reported limit may not be accurate or precise. Values flagged with U or UJ are fully usable and should be considered non-detected. The reported numerical result may be used for project objectives.

- Values without flags assigned have met all of the project data quality objectives and are suitable for all project data uses.

Statistical evaluations may be performed on some data sets. The results of data evaluation, including limitations of the use of the data, will be presented in the RI Report.

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TABLES

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

DQO Step	Preliminary Conceptual Site Model Exposure Media
1. State the Problem	<i>Historical information suggests that contamination exists in on-property soil in areas of former operations, and that contaminants may have migrated off-property during unauthorized releases, spills and overland runoff following storm events.</i>
2. Identify the Goal of the Study	<i>Conduct an investigation and assess the potential risks posed by releases of chemicals associated with the USOR Property, assess potential human health and ecological risks associated with past USOR property activities, and develop remedial alternatives to address any unacceptable risks.</i>
<i>AOI-1 ON-PROPERTY GROUNDWATER</i>	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in groundwater exceed applicable state and federal groundwater quality standards or AOI-1-specific risk-based criteria established for human receptors? 2. Do non-aqueous phase liquids (NAPLs) or the potential for NAPL based on COPC concentrations exist in groundwater?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the USOR Property i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ul style="list-style-type: none"> • Evaluate AOI-1 hydrogeology. • Evaluate concentrations of COPCs in uppermost groundwater-bearing unit. • Perform water well and water use survey of area. • Perform a water well records search within one mile of AOI-1. Confirm that nearby properties are provided potable water from the local municipality. • Perform subsurface utility survey to identify obstructions for drilling program and preferential pathways for migration of COPCs. • Identify ongoing and/or historic spills/releases that have or have the potential to impact groundwater. • Evaluate potential for discharge of groundwater to surface water. • Evaluate groundwater data to assess possibility of vapor intrusion (model).
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the groundwater contained within the USOR Property and any down-gradient groundwater that may have been impacted by on-property groundwater. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for groundwater is the entire upper-most groundwater bearing unit when evaluating the potential for vapor intrusion, or point of exposure wells if impacted groundwater discharges to surface water, or lower groundwater units if shown to be impacted.

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

DQO Step	Preliminary Conceptual Site Model Exposure Media
<i>AOI-1 ON-PROPERTY SOIL</i>	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in on-property soil pose an unacceptable risk to human health or ecological receptors? 2. Do COPCs in on-property subsurface soil pose an unacceptable risk to human health receptors? 3. What are the general soil characteristics to evaluate impact or COPC mobilization or sequestration in soil? 4. What is surface runoff drainage patterns at AOI-1?
2b. Define Alternative Actions	<p><i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the USOR Property i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i></p>
3. Identify Information Inputs	<ul style="list-style-type: none"> • Evaluate lateral and vertical extent of COPCs in samples of AOI-1 surface soil (0 to 0.5 ft bgs), shallow soils (0.5 to 5 ft bgs) and subsurface soil (greater than 5 ft bgs). • Collect general soil chemistry data (pH, TOC, grain size, etc.). • Evaluate topography and preferential surface water drainage pathways. • Identify ongoing and/or historic spills releases that have or have the potential to impact on-property soil.
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the soil contained within the USOR Property and any topographically lower areas that may have been impacted by surface runoff or direct releases. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for soil is 0 to 0.5 feet below ground surface (bgs), 0.5 to 5 ft. bgs, and 5 ft. bgs to the top of the saturated zone.

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

<i>AOI-1 ON-PROPERTY SEDIMENT</i> <i>(SOUTHWEST AREAS OF AOI-1 WHERE SURFACE WATER IS PRESENT FOR THE MAJORITY OF THE YEAR)</i>	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in on-property sediment pose an unacceptable risk to human health or ecological receptors? 2. What is the nature of habitat in areas where sediment is present?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the USOR Property i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ul style="list-style-type: none"> • Identify ongoing and/or historic spills/releases that have or have the potential to impact on-property sediment. • Collect sediment samples from areas of standing water on-property.
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the sediments contained within the low-lying areas in the southwest portion of the USOR property. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for these sediments is the biologically active zone for the areas with water standing for the majority of the year.
<i>AOI-1 ON-PROPERTY SURFACE WATER</i> <i>(SOUTHWEST AREAS OF AOI-1 WHERE SURFACE WATER IS PRESENT FOR THE MAJORITY OF THE YEAR)</i>	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in on-property surface water in the southwest portion of the USOR Property pose an unacceptable risk to human health or ecological receptors? 2. What is the general chemistry of on-property surface water? 3. What is the nature of the habitat in areas where on-property surface water is present?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the USOR Property i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ul style="list-style-type: none"> • Identify ongoing and/or historic spills/releases that have or have the potential to impact on-property surface water. • Collect data necessary to characterize origin of standing water. • Collect surface water samples in standing water for analysis of COPCs.

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the low-lying area at the southwest portion of the USOR Property with standing water. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for surface water is a depth approximately halfway between the surface and the bottom of the standing water.
<i>ON-PROPERTY AND OFF-PROPERTY AIR</i>	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in on-property and off-property soil or groundwater pose an unacceptable risk to human health via inhalation? 2. How do characteristics such as the presence and quality of vegetative cover, soil type and local meteorological data effect on- and off-property air concentrations (outdoor ambient air as well as indoor air)?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the USOR Property i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ol style="list-style-type: none"> 1. Use on-property soil and groundwater COPC concentration data and AOI-1-specific information to estimate or model potential emissions of volatile organic compounds and fugitive dust in on-property and off-property air.
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are affected area of soil and groundwater. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for this pathway will be surface soil for fugitive dust generation, subsurface for VOC emissions and impacted subsurface soil and groundwater for indoor VOC intrusion.

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

OFF-PROPERTY SURFACE SOIL	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in off-property soil pose an unacceptable risk to human health or ecological receptors? 2. Do COPCs in on-property and off-property soil or groundwater pose an unacceptable risk to human health via inhalation? 3. What are the general soil characteristics to evaluate impact or COPC mobilization or sequestration in soil? 4. What are surface runoff drainage patterns in the off-property area?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the USOR Property i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ol style="list-style-type: none"> 1. Evaluate lateral and vertical extent of COPCs in samples of off-property surface soil (0 to 0.5 ft bgs), shallow soils (0.5 to 5 ft bgs) and subsurface soil (greater than 5 ft bgs), depending on the nature of the soil area being investigated.. 2. Collect general soil chemistry data (pH, TOC, grain size, etc.). 3. Evaluate topography and preferential surface water drainage pathways. 4. Identify ongoing and/or historic spills releases that have or have the potential to impact off-property soil.
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the off-property soil outside of the USOR property extending to Vince Bayou. • The PCSMs show the receptors of potential concern for this pathway. The sampling unit for soil is 0 to 0.5 feet below ground surface (bgs), 0.5 to 5 ft. bgs, and 5 ft. bgs to the top of the saturated zone, depending on the nature of the soil area being investigated.
OFF-PROPERTY SURFACE WATER	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in surface water in Vince Bayou and Little Vince Bayou pose an unacceptable risk to human health or ecological receptors? 2. Do COPCs in surface water in background areas pose an unacceptable risk to human health or ecological receptors? 3. What is the general chemistry of surface water (near AOI-1 and in background areas)? 4. What is the watershed sub-basin and what are the associated uses of the off-property surface water? 5. What is the nature of the habitat in areas where off-property surface water is present? 6. What are the surface water flow characteristics in Vince Bayou and Little Vince Bayou?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of AOI-1 i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

3. Identify Information Inputs	<ol style="list-style-type: none"> 1. Delineate the boundary and drainage within the watershed sub-basin. 2. Identify potential land use practices that might have impacted surface water adjacent to AOI-1. 3. Identify on-going and/or historic spills/releases that have or have the potential to impact surface water. 4. Collect data to characterize surface water flow regime (e.g., flow velocity, groundwater to surface water interactions, etc.). 5. Evaluate the surface water quality and the potential presence of COPCs in surface water.
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the surface water in Vince Bayou and Little Vince Bayou near the USOR Property. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for surface water is a depth approximately halfway between the surface and the bottom of the water body in Vince Bayou and Little Vince Bayou and background areas.
<i>OFF-PROPERTY SEDIMENT</i>	
2a. Identify the Principal Study Questions	<ol style="list-style-type: none"> 1. Do COPCs in off-property sediment pose an unacceptable risk to human health or ecological receptors? 2. Do COPCs in off-property sediment in background areas pose an unacceptable risk to human health or ecological receptors? 3. What is the nature of habitat in areas where sediment is present? 4. What is the general chemistry and physical characteristics of off-property sediment (near the USOR Property and in background areas)?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of AOI-1 i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ol style="list-style-type: none"> 1. Identify ongoing and/or historic spills/releases that have or have the potential to impact sediment in Vince Bayou or Little Vince Bayou. 2. Collect sediment samples from Vince Bayou and background areas upstream in Vince Bayou and Little Vince Bayou.
4. Identify the Boundaries of the Study	<ul style="list-style-type: none"> • The spatial boundaries of the project are the sediments in Vince Bayou and Little Vince Bayou near the USOR Property. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for these sediments is the biologically active zone in Vince Bayou and Little Vince Bayou and background sediment.

TABLE 1 – DATA QUALITY OBJECTIVES FOR AOI-1

<i>FISH AND SHELLFISH</i>	
2a. Identify the Principal Study Questions	1. Do COPCs in Vince Bayou and Little Vince Bayou fish tissue pose an unacceptable risk to human health or ecological receptors?
2b. Define Alternative Actions	<i>The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of AOI-1 i) require no further evaluation or selection of a remedy; or ii) warrant additional assessment or selection of a remedy.</i>
3. Identify Information Inputs	<ul style="list-style-type: none"> • Collect samples from finfish species (legal size limit) commonly caught in the area and consumed; and samples from shellfish caught in the vicinity of AOI-1. • Measure USOR-Property-related COPCs in fish tissue samples collected (COPCs, excluding essential nutrients, detected above sample quantitation limits (SQLs) and background in the sediment samples will determine the list of COPCs to be analyzed in fish tissue samples). • Validate the analytical data. • If warranted, analyze background fish tissue samples for selected COPCs reported in fish tissue samples. • QA/QC samples: Collect 1 field duplicate and 1 MS/MSD sample per species for COPC analyses. • Analytical method detection limit targets will be identified following sediment sampling.
4. Define Boundaries of the Study	<ul style="list-style-type: none"> • The boundaries are the approximate USOR Property boundaries as extended to the adjacent Vince Bayou. Background samples will be collected from a designated area upstream of this area as well as in Little Vince Bayou. • No vertical boundaries – fish may be sampled from any depth. • The PCSMs show the receptors of potential concern for this pathway. • The sampling unit for fish and shellfish are individual fillet samples although composite shellfish samples may be necessary to provide adequate sample volume.

Table 2 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Metals

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ^{3,7}	Surface Water (Chronic Marine) ^{3,7,8}	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing} ⁵	Groundwater Industrial GW ⁵ GW _{Ing} ⁵	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3} ⁵	Groundwater Industrial GW ⁵ GW _{Class3} ⁵
Aluminum	7429-90-5	SW 6010D/6020B	0.010	9.9E-01	1.0E-01	NA	2.4E+01	7.3E+01	2.0E+01	2.4E+03	7.3E+03
Antimony	7440-36-0	SW 6010D/6020B	0.0050	8.8E-02	5.0E-01	1.1E+00	6.0E-03	6.0E-03	6.0E-03	6.0E-01	6.0E-01
Arsenic	7440-38-2	SW 6010D/6020B	0.0050	3.4E-01	7.8E-02	1.0E-02	1.0E-02	1.0E-02	5.2E-05	1.0E+00	1.0E+00
Barium	7440-39-3	SW 6010D/6020B	0.0050	1.1E-01	2.5E+01	NA	2.0E+00	2.0E+00	2.0E+00	2.0E+02	2.0E+02
Beryllium	7440-41-7	SW 6010D/6020B	0.0020	1.3E-01	1.0E-01	NA	4.0E-03	4.0E-03	4.0E-03	4.0E-01	4.0E-01
Boron	7440-42-8	SW 6010D/6020B	0.0050	3.0E-02	1.2E+00	NA	4.9E+00	1.5E+01	4.0E+00	4.9E+02	1.5E+03
Cadmium (d)	7440-43-9	SW 6010D/6020B	0.0020	4.4E-03	8.8E-03	NA	5.0E-03	5.0E-03	5.0E-03	5.0E-01	5.0E-01
Chromium (d)	7440-47-3	SW 6010D/6020B	0.0050	3.2E-01	1.0E-01	NA	1.0E-01	1.0E-01	2.2E+01	1.0E+01	1.0E+01
Cobalt	7440-48-4	SW 6010D/6020B	0.0050	4.5E+01	1.0E-03	NA	2.4E-01	7.3E-01	6.0E-03	2.4E+01	7.3E+01
Copper (d)	7440-50-8	SW 6010D/6020B	0.0050	7.4E-03	3.6E-03	NA	1.3E+00	1.3E+00	8.0E-01	1.3E+02	1.3E+02
Lead (d)	7439-92-1	SW 6010D/6020B	0.0050	3.0E-02	5.3E-03	3.8E-03	1.5E-02	1.5E-02	1.5E-02	1.5E+00	1.5E+00
Manganese	7439-96-5	SW 6010D/6020B	0.0050	2.3E+00	1.0E-01	1.0E-01	3.4E+00	1.0E+01	4.3E-01	3.4E+02	1.0E+03
Mercury	7439-97-6	SW 7470A	0.00020	2.4E-03	1.1E-03	1.2E-05	2.0E-03	2.0E-03	6.3E-04	2.0E-01	2.0E-01
Nickel (d)	7440-02-0	SW 6010D/6020B	0.0050	2.6E-01	1.3E-02	1.1E+00	4.9E-01	1.5E+00	3.9E-01	4.9E+01	1.5E+02
Selenium	7782-49-2	SW 6010D/6020B	0.0050	2.0E-02	1.4E-01	4.2E+00	5.0E-02	5.0E-02	5.0E-02	5.0E+00	5.0E+00
Silver (d)	7440-22-4	SW 6010D/6020B	0.0050	1.0E-03	1.9E-04	NA	1.2E-01	3.7E-01	9.4E-02	1.2E+01	3.7E+01
Thallium	7440-28-0	SW 6010D/6020B	0.0020	1.1E-01	2.1E-02	2.3E-04	2.0E-03	2.0E-03	2.0E-04	2.0E-01	2.0E-01
Vanadium	7440-62-2	SW 6010D/6020B	0.0050	2.8E-01	5.0E-02	NA	4.4E-02	1.3E-01	8.6E-02	4.4E+00	1.3E+01
Zinc (d)	7440-66-6	SW 6010D/6020B	0.0050	6.5E-02	8.4E-02	2.6E+01	7.3E+00	2.2E+01	6.0E+00	7.3E+02	2.2E+03

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Aquatic Life Risk-Based Exposure Limits. May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Human Health Risk-Based Exposure Limits (Fish only). May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁵ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁶ Regional Screening Levels, Lower of Tapwater or Maximum Contaminant Level, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁷ Screening Quick Reference Table for Inorganics in Water, NOAA 2008.

⁸ Wilson and Hyne, 1997

(d) – Dissolved metals

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 3 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Herbicides and Pesticides

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ³	Surface Water (Chronic Marine) ³	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing} ⁵	Groundwater Industrial GW ⁵ GW _{Ing} ⁵	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3} ⁵	Groundwater Industrial GW ⁵ GW _{Class3} ⁵
2,4,5-T	93-76-5	SW 8151A	0.00020	NA	NA	NA	2.4E-01	7.3E-01	1.6E-01	2.4E+01	7.3E+01
2,4,5-TP (Silvex)	93-72-1	SW 8151A	0.00020	NA	NA	2.1E-02	5.0E-02	5.0E-02	5.0E-02	5.0E+00	5.0E+00
2,4-D	94-75-7	SW 8151A	0.00020	NA	NA	NA	7.0E-02	7.0E-02	7.0E-02	7.0E+00	7.0E+00
2,4-DB	94-82-6	SW 8151A	0.00040	NA	NA	NA	2.0E-01	5.8E-01	1.2E-01	2.0E+01	5.8E+01
4,4'-DDD	72-54-8	SW 8081B	0.0000025	1.9E-04	2.5E-05	5.9E-06	3.8E-04	8.5E-04	3.1E-05	3.8E-01	8.5E-01
4,4'-DDE	72-55-9	SW 8081B	0.0000025	1.0E+00	1.4E-04	4.0E-06	2.7E-04	6.0E-04	2.3E-04	2.7E-01	6.0E-01
4,4'-DDT	50-29-3	SW 8081B	0.0000025	1.1E-03	1.0E-06	4.0E-06	2.7E-04	6.0E-03	2.3E-04	2.7E-01	6.0E-01
a-BHC	319-84-6	SW 8081B	0.0000012	4.5E-01	2.5E-02	9.3E-05	1.4E-05	3.2E-05	7.1E-06	1.4E-03	3.2E-03
Aldrin	309-00-2	SW 8081B	0.0000012	3.0E-03	1.3E-04	1.0E-06	5.4E-06	1.2E-05	4.6E-06	5.4E-04	1.2E-03
b-BHC	319-85-7	SW 8081B	0.0000012	5.0E-01	NA	3.3E-04	5.1E-05	1.1E-04	2.5E-05	5.1E-03	1.1E-02
cis-Chlordane	5103-71-9	SW 8081B	0.0000025	2.4E-03	4.0E-06	8.1E-06	2.6E-04	5.8E-04	2.2E-04	2.6E-01	5.8E-01
Dalapon	75-99-0	SW 8151A	0.00020	NA	NA	NA	2.0E-01	2.0E-01	2.0E-01	2.0E+01	2.0E+01
d-BHC	319-86-8	SW 8081B	0.0000012	2.5E-01	NA	4.1E-05	5.1E-05	1.1E-04	2.5E-05	5.1E-03	1.1E-02
Dicamba	1918-00-9	SW 8151A	0.00020	NA	NA	NA	7.3E-01	2.2E+00	5.7E-01	7.3E+01	2.2E+02
Dichloroprop	120-36-5	SW 8151A	0.00040	NA	NA	NA	2.4E-01	7.3E-01	NA	2.4E+01	7.3E+01
Dieldrin	60-57-1	SW 8081B	0.0000025	2.4E-04	2.0E-06	1.0E-06	5.7E-06	1.3E-05	1.7E-06	5.7E-04	1.3E-03
Dinoseb	88-85-7	SW 8151A	0.00030	NA	NA	NA	7.0E-03	7.0E-03	7.0E-03	7.0E-01	7.0E-01
Endosulfan I (alpha)	959-98-8	SW 8081B	0.0000025	2.2E-04	9.0E-06	8.9E-02	4.9E-02	1.5E-01	1.0E-01	4.9E+00	1.5E+01
Endosulfan II (beta)	33213-65-9	SW 8081B	0.0000025	2.2E-04	9.0E-06	8.9E-02	1.5E-01	4.4E-01	1.0E-01	1.5E+01	4.4E+01
Endosulfan sulfate	1031-07-8	SW 8081B	0.0000025	2.2E-04	9.0E-06	8.9E-02	1.5E-01	4.4E-01	1.0E-01	1.5E+01	4.4E+01
Endrin	72-20-8	SW 8081B	0.0000025	8.6E-05	2.0E-06	2.0E-04	2.0E-03	2.0E-03	2.0E-03	2.0E-01	2.0E-01
Endrin aldehyde	7421-93-4	SW 8081B	0.0000025	3.6E+01	NA	3.0E-04	7.3E-03	2.2E-02	2.0E-03	7.3E-01	2.2E+00
Endrin ketone	53494-70-5	SW 8081B	0.0000025	NA	NA	NA	7.3E-03	2.2E-02	2.0E-03	7.3E-01	2.2E+00
g-BHC (Lindane)	58-89-9	SW 8081B	0.0000012	1.1E-03	1.6E-05	6.2E-03	2.0E-04	2.0E-04	4.1E-05	2.0E-02	2.0E-02
Heptachlor	76-44-8	SW 8081B	0.0000012	5.2E-04	4.0E-06	1.5E-06	4.0E-04	4.0E-04	2.0E-06	4.0E-02	4.0E-02
Heptachlor epoxide	1024-57-3	SW 8081B	0.0000012	5.2E-04	3.6E-06	7.5E-07	2.0E-04	2.0E-04	3.8E-06	2.0E-02	2.0E-02
MCPA	94-74-6	SW 8151A	0.030	NA	4.2E-03	NA	1.2E-02	3.7E-02	7.5E-03	1.2E+00	3.7E+00
MCPP	93-65-2	SW 8151A	0.030	NA	NA	NA	2.4E-02	7.3E-02	1.6E-02	2.4E+00	7.3E+00
Methoxychlor	72-43-5	SW 8081B	0.000012	NA	3.0E-05	1.6E-03	4.0E-02	4.0E-02	3.7E-02	4.0E+00	4.0E+00
Toxaphene	8001-35-2	SW 8081B	0.000025	7.8E-04	2.0E-07	5.3E-06	3.0E-03	3.0E-03	1.5E-05	3.0E-01	3.0E-01
trans-Chlordane	5103-74-2	SW 8081B	0.0000025	2.4E-03	4.0E-06	8.1E-06	2.6E-04	5.8E-04	2.2E-04	2.6E-01	5.8E-01

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Aquatic Life Risk-Based Exposure Limits. May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Human Health Risk-Based Exposure Limits (Fish only). May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁵ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁶ Regional Screening Levels, Lower of Tapwater or Maximum Contaminant Level, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁷ Screening Quick Reference Table for Organics in Water, NOAA 2008.

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 4 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Semivolatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ^{3,7}	Surface Water (Chronic Marine) ^{3,7}	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing} ⁵	Groundwater Industrial GW ⁵ GW _{Ing} ⁵	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3} ⁵	Groundwater Industrial GW ⁵ GW _{Class3} ⁵
1,1'-Biphenyl	92-52-4	SW 8270D	0.0002	NA	NA	NA	1.2E+01	3.7E+01	8.3E-04	1.2E+03	3.7E+03
1,2,4,5-Tetrachlorobenzene	95-94-3	SW 8270D	0.0002	2.5E-03	1.3E-01	7.1E-04	7.3E-03	2.2E-02	1.7E-03	7.3E-01	2.2E+00
1,4-Dioxane	123-91-1	SW 8270D	0.010	NA	NA'	NA	9.1E-04	2.0E-03	7.8E-04	9.1E-02	2.0E-01
1-Methylnaphthalene * ^T	90-12-0	SW 8270D	0.0002	NA	NA	NA	3.1E-03	7.0E-03	1.1E-03	3.1E-01	7.0E-01
2,2'-Oxybis(1-chloropropane)	108-60-1	SW 8270D	0.0002	3.8E+01	NA	6.5E+01	1.3E-03	2.9E-03	3.6E-04	1.3E-01	2.9E-01
2,3,4,6-Tetrachlorophenol	58-90-2	SW 8270D	0.0002	NA	4.4E-02	NA	7.3E-01	2.2E+00	2.4E-01	7.3E+01	2.2E+02
2,4,5-Trichlorophenol	95-95-4	SW 8270D	0.0002	1.4E-01	1.2E-02	2.4E+00	2.4E+00	7.3E+00	1.2E+00	2.4E+02	7.3E+02
2,4,6-Trichlorophenol	88-06-2	SW 8270D	0.0002	8.1E-02	6.1E-02	2.4E-02	2.4E-02	7.3E-02	4.0E-03	2.4E+00	7.3E+00
2,4-Dichlorophenol	120-83-2	SW 8270D	0.0002	5.1E-01	NA	2.9E-01	7.3E-02	2.2E-01	4.6E-02	7.3E+00	2.2E+01
2,4-Dimethylphenol	105-67-9	SW 8270D	0.0002	6.3E-01	NA	5.7E-01	4.9E-01	1.5E+00	3.6E-01	4.9E+01	1.5E+02
2,4-Dinitrophenol	51-28-5	SW 8270D	0.001	1.9E-01	6.7E-01	5.3E+00	4.9E-02	1.5E-01	3.9E-02	4.9E+00	1.5E+01
2,4-Dinitrotoluene	121-14-2	SW 8270D	0.0002	7.3E+00	3.7E-01	3.4E-02	1.3E-04	3.0E-04	2.4E-04	1.3E-02	3.0E-02
2,6-Dinitrotoluene	606-20-2	SW 8270D	0.0002	NA	NA	NA	1.3E-04	3.0E-04	4.8E-05	1.3E-02	3.0E-02
2-Chloronaphthalene	91-58-7	SW 8270D	0.0002	3.2E-01	7.5E-03	1.6E+00	2.0E+00	5.8E+00	7.5E-01	2.0E+02	5.8E+02
2-Chlorophenol	95-57-8	SW 8270D	0.0002	7.8E-01	2.7E-01	1.5E-01	1.2E-01	3.7E-01	9.1E-02	1.2E+01	3.7E+01
2-Methylnaphthalene * ^T	91-57-6	SW 8270D	0.0002	3.8E-01	3.0E-02	NA	9.8E-02	2.9E-01	3.6E-02	9.8E+00	2.9E+01
2-Methylphenol (o-Cresol)	95-48-7	SW 8270D	0.0002	3.4E+00	5.1E-01	9.3E+00	1.2E+00	3.7E+00	9.3E-01	1.2E+02	3.7E+02
2-Nitroaniline	88-74-4	SW 8270D	0.0002	NA	NA	NA	7.3E-03	2.2E-02	1.9E-01	7.3E-01	2.2E+00
2-Nitrophenol	88-75-5	SW 8270D	0.0002	5.8E+00	1.5E+00	NA	4.9E-02	1.5E-01	NA	4.9E+00	1.5E+01
3,3'-Dichlorobenzidine	91-94-1	SW 8270D	0.0002	3.2E-01	3.7E-02	4.4E-04	2.0E-04	4.5E-04	1.2E-04	2.0E-02	4.5E-02
3-Methylphenol (m-Cresol)	108-39-4	SW 8270D	0.0002	2.3E-01	NA	9.3E+00	1.2E+00	3.7E+00	9.3E-01	1.2E+02	3.7E+02
3-Nitroaniline	99-09-2	SW 8270D	0.0002	NA	NA	NA	7.3E-03	2.2E-02	NA	7.3E-01	2.2E+00
4,6-Dinitro-2-methylphenol	534-52-1	SW 8270D	0.0002	6.9E-02	NA	2.8E-01	2.4E-03	7.3E-03	1.5E-03	2.4E-01	7.3E-01
4-Bromophenyl phenyl ether	101-55-3	SW 8270D	0.0002	NA	NA	NA	6.1E-06	1.4E-05	NA	6.1E-04	1.4E-03
4-Chloro-3-methylphenol	59-50-7	SW 8270D	0.0002	NA	NA	NA	1.2E-01	3.7E-01	1.4E+00	1.2E+01	3.7E+01
4-Chlorophenyl phenyl ether	7005-72-3	SW 8270D	0.0002	NA	NA	NA	6.1E-06	1.4E-05	NA	6.1E-04	1.4E-03
4-Methylphenol (p-Cresol)	106-44-5	SW 8270D	0.0002	1.6E+00	5.1E-01	9.3E+00	1.2E-01	3.7E-01	1.9E+00	1.2E+01	3.7E+01
4-Nitroaniline	100-01-6	SW 8270D	0.0002	NA	NA	NA	4.6E-03	1.0E-02	3.8E-03	4.6E-01	1.0E+00
4-Nitrophenol	100-02-7	SW 8270D	0.001	3.2E+00	3.6E-01	NA	4.9E-02	1.5E-01	NA	4.9E+00	1.5E+01
Acenaphthene * ^T	83-32-9	SW 8270D	0.0002	1.7E+00	4.0E-02	9.9E-01	1.5E+00	4.4E+00	5.3E-01	1.5E+02	4.4E+02
Acenaphthylene * ^T	208-96-8	SW 8270D	0.0002	NA	NA	NA	1.5E+00	4.4E+00	NA	1.5E+02	4.4E+02
Acetophenone	98-86-2	SW 8270D	0.0002	NA	NA	NA	2.4E+00	7.3E+00	1.9E+00	2.4E+02	7.3E+02
Anthracene * ^T	120-12-7	SW 8270D	0.0002	1.8E-03	1.8E-04	4.0E+01	7.3E+00	2.2E+01	1.8E+00	7.3E+02	2.2E+03
Atrazine	1912-24-9	SW 8270D	0.0002	NA	NA	NA	3.0E-03	3.0E-03	3.0E-04	3.0E-01	3.0E-01
Benzaldehyde	100-52-7	SW 8270D	0.0002	NA	NA	NA	2.4E+00	7.3E+00	1.9E+00	2.4E+02	7.3E+02
Benzo(a)anthracene * ^T	56-55-3	SW 8270D	0.0002	2.1E-01	NA	3.3E-03	1.3E-04	2.8E-04	3.4E-05	1.3E-01	2.8E-01
Benzo(a)pyrene * ^T	50-32-8	SW 8270D	0.0002	2.4E-04	NA	3.3E-04	2.0E-04	2.0E-04	3.4E-06	2.0E-02	2.0E-02
Benzo(b)fluoranthene * ^T	205-99-2	SW 8270D	0.0002	NA	NA	1.8E-04	1.3E-04	2.8E-03	3.4E-05	1.3E-01	2.8E-01
Benzo(ghi)perylene * ^T	191-24-2	SW 8270D	0.0002	NA	NA	NA	7.3E-01	2.2E+00	NA	7.3E+01	2.2E+02
Benzo(k)fluoranthene * ^T	207-08-9	SW 8270D	0.0002	NA	NA	1.8E-04	1.3E-02	2.8E-02	3.4E-04	1.3E+00	2.8E+00
bis(2-Chloroethoxy)methane	111-91-1	SW 8270D	0.0002	1.1E+01	6.4E+00	NA	8.3E-05	1.9E-04	5.9E-02	8.3E-03	1.9E-02

Table 4 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Semivolatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ^{3,7}	Surface Water (Chronic Marine) ^{3,7}	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing} ⁵	Groundwater Industrial GW ⁵ GW _{Ing} ⁵	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3} ⁵	Groundwater Industrial GW ⁵ GW _{Class3} ⁵
bis(2-Chloroethyl)ether	111-44-4	SW 8270D	0.0002	7.2E+01	NA	1.0E-02	8.3E-05	1.9E-04	1.4E-05	8.3E-03	1.9E-02
bis(2-Ethylhexyl)phthalate	117-81-7	SW 8270D	0.0002	4.0E-01	3.6E-01	4.1E-02	6.0E-03	6.0E-03	5.6E-03	6.0E-01	6.0E-01
Butyl benzyl phthalate	85-68-7	SW 8270D	0.0002	5.6E-01	1.5E-01	1.9E+00	4.8E-02	1.1E-01	1.6E-02	4.8E+01	1.1E+02
Caprolactam	105-60-2	SW 8270D	0.0002	NA	NA	NA	1.2E+01	3.7E+01	9.9E+00	1.2E+03	3.7E+03
Carbazole	86-74-8	SW 8270D	0.0002	NA	NA	NA	4.6E-03	1.0E-02	NA	4.6E+00	1.0E+01
Chrysene * ^T	218-01-9	SW 8270D	0.0002	2.1E-01	NA	3.3E-01	1.3E-01	2.8E-01	3.4E-03	1.3E+01	2.8E+01
Dibenz(a,h)anthracene * ^T	53-70-3	SW 8270D	0.0002	1.5E-01	NA	1.8E-04	1.3E-05	2.8E-05	3.4E-06	1.3E-02	2.8E-02
Dibenzofuran	132-64-9	SW 8270D	0.0002	5.6E-01	6.5E-02	NA	9.8E-02	2.9E-01	7.9E-03	9.8E+00	2.9E+01
Diethyl phthalate	84-66-2	SW 8270D	0.0002	6.3E+00	4.4E-01	4.4E+01	2.0E+01	5.8E+01	1.5E+01	2.0E+03	5.8E+03
Dimethyl phthalate	131-11-3	SW 8270D	0.0002	9.4E-01	5.8E-01	1.1E+03	2.0E+01	5.8E+01	NA	2.0E+03	5.8E+03
Di-n-butyl phthalate	84-74-2	SW 8270D	0.0002	2.2E-01	5.0E-03	3.0E+00	2.4E+00	7.3E+00	9.0E-01	2.4E+02	7.3E+02
Di-n-octyl phthalate	117-84-0	SW 8270D	0.0002	6.7E-01	3.4E-03	NA	2.4E-01	7.3E-01	2.0E-01	2.4E+01	7.3E+01
Fluoranthene * ^T	206-44-0	SW 8270D	0.0002	4.0E+00	3.0E-03	1.4E-01	9.8E-01	2.9E+00	8.0E-01	9.8E+01	2.9E+02
Fluorene * ^T	86-73-7	SW 8270D	0.0002	6.4E-02	5.0E-02	5.3E+00	9.8E-01	2.9E+00	2.9E-01	9.8E+01	2.9E+02
Hexachlorobenzene	118-74-1	SW 8270D	0.0002	6.0E-03	1.3E-01	4.5E-06	1.0E-03	1.0E-03	4.9E-05	1.0E-01	1.0E-01
Hexachlorobutadiene	87-68-3	SW 8270D	0.0002	9.0E-02	3.2E-04	2.7E-01	1.2E-03	2.6E-03	3.0E-04	1.2E-01	2.6E+00
Hexachlorocyclopentadiene	77-47-4	SW 8270D	0.0002	2.1E-03	7.0E-05	1.1E+00	5.0E-02	5.0E-02	3.1E-02	5.0E+00	5.0E+00
Hexachloroethane	67-72-1	SW 8270D	0.0002	2.1E-01	9.4E-03	1.2E-02	1.7E-02	5.1E-02	9.0E-04	1.7E+00	5.1E+00
Indeno(1,2,3-cd)pyrene * ^T	193-39-5	SW 8270D	0.0002	NA	NA	1.8E-04	1.3E-04	2.8E-04	3.4E-05	1.3E-01	2.8E-01
Isophorone	78-59-1	SW 8270D	0.0002	3.6E+01	6.5E-01	9.6E+00	9.6E-02	2.2E-01	7.8E-02	9.6E+00	2.2E+01
Naphthalene * ^T	91-20-3	SW 8270D	0.0002	1.5E+00	1.3E-01	NA	4.9E-01	1.5E+00	1.7E-04	4.9E+01	1.5E+02
Nitrobenzene	98-95-3	SW 8270D	0.0002	2.7E+02	6.7E-02	1.9E+00	4.9E-02	1.5E-01	1.4E-04	4.9E+00	1.5E+01
N-Nitrosodi-n-propylamine	621-64-7	SW 8270D	0.0002	3.8E+00	1.2E-01	5.1E-03	1.3E-05	2.9E-05	1.1E-05	1.3E-03	2.9E-03
N-Nitrosodiphenylamine	86-30-6	SW 8270D	0.0002	1.7E+00	1.7E+02	6.0E-02	1.9E-02	4.2E-02	1.2E-02	1.9E+00	4.2E+01
Pentachlorophenol	87-86-5	SW 8270D	0.0002	3.2E-03	9.6E-03	9.1E-03	1.0E-03	1.0E-03	4.0E-05	1.0E-01	1.0E-01
Phenanthrene * ^T	85-01-8	SW 8270D	0.0002	3.0E-02	4.6E-03	NA	7.3E-01	2.2E+00	NA	7.3E+01	2.2E+02
Phenol	108-95-2	SW 8270D	0.0002	1.0E+01	2.8E+00	8.6E+02	7.3E+00	2.2E+01	5.8E+00	7.3E+02	2.2E+03
Pyrene * ^T	129-00-0	SW 8270D	0.0002	2.1E-01	2.4E-04	4.0E+00	7.3E-01	2.2E+00	1.2E-01	7.3E+01	2.2E+02
Total PAHs	TPAH	SW 8270D	0.0002	NA	NA	NA	NA	NA	NA	NA	NA

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Aquatic Life Risk-Based Exposure Limits. May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Human Health Risk-Based Exposure Limits (Fish only). May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁵ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁶ Regional Screening Levels, Lower of Tapwater or Maximum Contaminant Level, http://www.epa.gov/reg3hwm/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁷ Screening Quick Reference Table for Organics in Water, NOAA 2008.

MQL - Method Quantitation Limit

NA – Not Available

*^T - These compounds are summed to provide the concentration of Total Polynuclear Aromatic Hydrocarbons (PAHs).

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 5 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Volatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ^{3,7}	Surface Water (Chronic Marine) ^{3,7}	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing} ⁵	Groundwater Industrial GW ⁵ GW _{Ing} ⁵	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3} ⁵	Groundwater Industrial GW ⁵ GW _{Class3} ⁵
1,1,1,2-Tetrachloroethane	630-20-6	SW 8260B	0.0010	NA	NA	NA	3.5E-03	7.9E-03	5.7E-04	3.5E-01	7.9E-01
1,1,1-Trichloroethane	71-55-6	SW 8260B	0.0010	1.5E+01	1.6E+00	9.6E+02	2.0E-01	2.0E-01	2.0E-01	2.0E+01	2.0E+01
1,1,2,2-Tetrachloroethane	79-34-5	SW 8260B	0.0010	2.8E+00	4.5E-01	4.0E-02	4.6E-04	1.0E-03	7.6E-05	4.6E-02	1.0E-01
1,1,2-Trichloroethane	79-00-5	SW 8260B	0.0010	5.4E+00	2.8E-01	3.0E-01	5.0E-03	5.0E-03	2.8E-04	5.0E-01	5.0E-01
1,1,2-Trichlorotrifluoroethane	76-13-1	SW 8260B	0.0010	1.2E+00	NA	NA	7.3E+02	2.2E+03	5.5E+01	7.3E+04	2.2E+05
1,1-Dichloroethane	75-34-3	SW 8260B	0.0010	1.5E+01	NA	NA	4.9E+00	1.5E+01	2.7E-03	4.9E+02	1.5E+03
1,1-Dichloroethene	75-35-4	SW 8260B	0.0010	9.1E+00	1.3E+01	2.4E+01	7.0E-03	7.0E-03	7.0E-03	7.0E-01	7.0E-01
1,2,3-Trichlorobenzene	87-61-6	SW 8260B	0.0010	NA	NA	NA	7.3E-02	2.2E-01	7.0E-03	7.3E+00	2.2E+01
1,2,4-Trichlorobenzene	120-82-1	SW 8260B	0.0010	3.1E-01	2.3E-02	7.0E-02	7.0E-02	7.0E-02	1.1E-03	7.0E+00	7.0E+00
1,2,4-Trimethylbenzene	95-63-6	SW 8260B	0.0010	4.6E-01	2.2E-01	NA	1.2E+00	3.7E+00	1.5E-02	1.2E+02	3.7E+02
1,2-Dibromoethane	106-93-4	SW 8260B	0.0010	NA	NA	4.2E-03	5.0E-05	5.0E-05	7.5E-06	5.0E-03	5.0E-03
1,2-Dichlorobenzene	95-50-1	SW 8260B	0.0010	6.6E-01	9.9E-02	4.3E+00	6.0E-01	6.0E-01	3.0E-01	6.0E+01	6.0E+01
1,2-Dichloroethane	107-06-2	SW 8260B	0.0010	3.8E+01	5.7E+00	5.5E-01	5.0E-03	5.0E-03	1.7E-04	5.0E-01	5.0E-01
1,2-Dichloropropane	78-87-5	SW 8260B	0.0010	1.1E+01	2.4E+00	2.3E-01	5.0E-03	5.0E-03	4.4E-04	5.0E-01	5.0E-01
1,3,5-Trimethylbenzene	108-67-8	SW 8260B	0.0010	4.2E-01	NA	NA	1.2E+00	3.7E+00	1.2E-01	1.2E+02	3.7E+02
1,3-Dichlorobenzene	541-73-1	SW 8260B	0.0010	1.5E-01	1.4E-01	1.4E+00	7.3E-01	2.2E+00	NA	7.3E+01	2.2E+02
1,4-Dichlorobenzene	106-46-7	SW 8260B	0.0010	6.6E-01	9.9E-02	1.9E-01	7.5E-02	7.5E-02	4.8E-04	7.5E+00	7.5E+00
2-Butanone (MEK)	78-93-3	SW 8260B	0.0020	2.5E+02	NA	9.9E+02	1.5E+01	4.4E+01	5.6E+00	1.5E+03	4.4E+03
2-Hexanone	591-78-6	SW 8260B	0.0020	3.7E+01	NA	NA	1.2E-01	3.7E-01	3.8E-02	1.2E+01	3.7E+01
4-Methyl-2-pentanone (MIBK)	108-10-1	SW 8260B	0.0020	1.6E+02	6.2E+01	NA	2.0E+00	5.8E+00	1.2E+00	2.0E+02	5.8E+02
Acetone	67-64-1	SW 8260B	0.0020	6.1E+02	2.8E+02	NA	2.2E+01	6.6E+01	1.4E+01	2.2E+03	6.6E+03
Benzene	71-43-2	SW 8260B	0.0010	2.3E+00	1.1E-01	5.1E-01	5.0E-03	5.0E-03	4.5E-04	5.0E-01	5.0E-01
Bromodichloromethane	75-27-4	SW 8260B	0.0010	1.3E+01	6.4E+00	3.2E-01	1.5E-03	3.3E-03	1.3E-04	1.5E-01	3.3E-01
Bromoform	75-25-2	SW 8260B	0.0010	9.0E-01	1.2E+00	2.2E+00	1.2E-02	2.6E-02	9.2E-03	1.2E+00	2.6E+00
Bromomethane	74-83-9	SW 8260B	0.0010	6.6E-01	6.0E-01	1.5E+00	3.4E-02	1.0E-01	7.5E-03	3.4E+00	1.0E+01
Carbon disulfide	75-15-0	SW 8260B	0.0020	7.0E-01	NA	NA	2.4E+00	7.3E+00	8.1E-01	2.4E+02	7.3E+02
Carbon tetrachloride	56-23-5	SW 8260B	0.0010	1.8E-01	1.5E+00	3.1E-02	5.0E-03	5.0E-03	4.5E-04	5.0E-01	5.0E-01
Chlorobenzene	108-90-7	SW 8260B	0.0010	NA	1.1E-01	5.2E+00	1.0E-01	1.0E-01	7.8E-02	1.0E+01	1.0E+01
Chloroethane	75-00-3	SW 8260B	0.0010	NA	NA	NA	9.8E+00	2.9E+01	2.1E+01	9.8E+02	2.9E+03
Chloroform	67-66-3	SW 8260B	0.0010	5.3E+00	4.1E+00	7.1E+00	2.4E-01	7.3E-01	2.2E-04	2.4E+01	7.3E+01
Chloromethane	74-87-3	SW 8260B	0.0010	1.7E+02	1.4E+01	NA	7.0E-03	1.6E-02	1.9E-01	7.0E-01	1.6E+00
cis -1,2-Dichloroethene	156-59-2	SW 8260B	0.0010	4.2E+01	6.8E-01	NA	7.0E-02	7.0E-02	3.6E-02	7.0E+00	7.0E+00
cis -1,3-Dichloropropene	10061-01-5	SW 8260B	0.0010	1.2E+00	4.0E-02	2.1E-01	1.7E-04	3.8E-04	4.7E-04	1.7E-02	3.8E-02
Cyclohexane	110-82-7	SW 8260B	0.0010	NA	NA	NA	1.2E+02	3.7E+02	1.3E+01	1.2E+04	3.7E+04
Dibromochloromethane	124-48-1	SW 8260B	0.0010	7.7E-01	6.4E+00	2.4E-01	1.1E-03	2.4E-03	1.7E-04	1.1E-01	2.4E-01
Dichlorodifluoromethane	75-71-8	SW 8260B	0.0010	1.2E+01	NA	NA	4.9E+00	1.5E+01	2.0E-01	4.9E+02	1.5E+03
Ethylbenzene	100-41-4	SW 8260B	0.0010	6.5E+00	2.5E-01	7.1E+00	7.0E-01	7.0E-01	1.5E-03	7.0E+01	7.0E+01
Isopropylbenzene (Cumene)	98-82-8	SW 8260B	0.0010	1.5E+00	NA	NA	2.4E+00	7.3E+00	4.5E-01	2.4E+02	7.3E+02
Methyl acetate	79-20-9	SW 8260B	0.0010	NA	NA	NA	2.4E+01	7.3E+01	2.0E+01	2.4E+03	7.3E+03
Methyl tert-butyl ether	1634-04-4	SW 8260B	0.0010	1.5E+02	1.8E+01	NA	2.4E-01	7.3E-01	1.4E-02	2.4E+01	7.3E+01
Methylcyclohexane	108-87-2	SW 8260B	0.0010	NA	NA	NA	1.2E+02	3.7E+02	NA	1.2E+04	3.7E+04

Table 5 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Volatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ^{3,7}	Surface Water (Chronic Marine) ^{3,7}	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing} ⁵	Groundwater Industrial GW ⁵ GW _{Ing} ⁵	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3} ⁵	Groundwater Industrial GW ⁵ GW _{Class3} ⁵
Methylene chloride	75-09-2	SW 8260B	0.0020	6.6E+01	5.4E+00	2.2E+01	5.0E-03	5.0E-03	5.0E-03	5.0E-01	5.0E-01
n-Butylbenzene	104-51-8	SW 8260B	0.0010	2.1E-01	NA	NA	1.2E+00	3.7E+00	1.0E+00	1.2E+02	3.7E+02
n-Propylbenzene	103-65-1	SW 8260B	0.0010	3.9E-01	NA	NA	9.8E-01	2.9E+00	6.6E-01	9.8E+01	2.9E+02
sec-Butylbenzene	135-98-8	SW 8260B	0.0010	2.5E-01	NA	NA	9.8E-01	2.9E+00	2.0E+00	9.8E+01	2.9E+02
Styrene	100-42-5	SW 8260B	0.0010	7.5E+00	4.6E-01	NA	1.0E-01	1.0E-01	1.0E-01	1.0E+01	1.0E+01
tert-Butylbenzene	98-06-6	SW 8260B	0.0010	2.9E-01	NA	NA	9.8E-01	2.9E+00	6.9E-01	9.8E+01	2.9E+02
Tetrachloroethene	127-18-4	SW 8260B	0.0010	4.7E+00	1.5E+00	5.3E-01	5.0E-03	5.0E-03	5.0E-03	5.0E-01	5.0E-01
Toluene	108-88-3	SW 8260B	0.0010	8.7E+00	4.8E-01	1.5E+01	1.0E+00	1.0E+00	1.0E+00	1.0E+02	1.0E+02
<i>trans</i> -1,2-Dichloroethene	156-60-5	SW 8260B	0.0010	6.6E+01	6.8E-01	1.0E+01	1.0E-01	1.0E-01	1.0E-01	1.0E+01	1.0E+01
<i>trans</i> -1,3-Dichloropropene	10061-02-6	SW 8260B	0.0010	1.2E+00	4.0E-02	2.1E-01	9.1E-04	2.0E-03	4.7E-04	9.1E-02	2.0E-01
Trichloroethene	79-01-6	SW 8260B	0.0010	3.3E+00	9.7E-01	8.2E-02	5.0E-03	5.0E-03	4.9E-04	5.0E-01	5.0E-01
Trichlorofluoromethane	75-69-4	SW 8260B	0.0010	5.2E+00	6.4E+00	NA	7.3E+00	2.2E+01	1.1E+00	7.3E+02	2.2E+03
Vinyl chloride	75-01-4	SW 8260B	0.0010	1.7E+01	NA	2.4E-02	2.0E-03	2.0E-03	1.9E-05	2.0E-01	2.0E-01
Xylenes, total	1330-20-7	SW 8260B	0.0030	4.0E+00	8.5E-01	NA	1.0E+01	1.0E+01	1.9E-01	1.0E+03	1.0E+03

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Aquatic Life Risk-Based Exposure Limits. May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Human Health Risk-Based Exposure Limits (Fish only). May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁵ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁶ Regional Screening Levels, Lower of Tapwater or Maximum Contaminant Level, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁷ Screening Quick Reference Table for Organics in Water, NOAA 2008.

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 6 - Analyte List and Preliminary Screening Values for Groundwater and Surface Water - Total Petroleum Hydrocarbons

Parameter	CAS RN ¹	Method ²	MQL (mg/L)	Surface Water (Acute Freshwater) ³	Surface Water (Chronic Marine) ³	Surface Water (Human Health) ⁴	Groundwater Residential GW ⁵ GW _{Ing}	Groundwater Industrial GW ⁵ GW _{Ing}	RSL ⁶	Groundwater Residential GW ⁵ GW _{Class3}	Groundwater Industrial GW ⁵ GW _{Class3}
C6 - C12	TPH-1005-1	TX1005	2.5	NA	NA	NA	9.8E-01	2.9E+00	3.3E-02	9.8E+01	2.9E+02
>C12 - C28	TPH-1005-2	TX1005	2.5	NA	NA	NA	9.8E-01	2.9E+00	1.0E-01	9.8E+01	2.9E+02
>C12 - C35	TPH-1005-3	TX1005	2.5	NA	NA	NA	9.8E-01	2.9E+00	8.0E-01	9.8E+01	2.9E+02
>C28 - C35	TPH-1005-4	TX1005	2.5	NA	NA	NA	9.8E-01	2.9E+00	6.0E+01	9.8E+01	2.9E+02

¹ Chemical Abstracts Service Registry Number; assigned for database

² SW: USEPA 1986

³ Aquatic Life Risk-Based Exposure Limits. May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Human Health Risk-Based Exposure Limits (Fish only). May 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁵ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁶ Regional Screening Levels, Lower of Tapwater or Maximum Contaminant Level, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 7 - Analyte List and Preliminary Screening Values for Soil and Sediment - Metals

Parameter	CAS RN ¹	Method ²	MQL (mg/kg)	Sediment (Ecological Freshwater) ^{3,4}	Sediment (Ecological Marine) ^{3,4}	Sediment (Human Health) ^{TotSed_{comb}} ⁵	Soil (Ecological) ⁶	Soils (Human Health- Residential) ^{TotSoil_{comb}} ⁷	Soils (Human Health- Industrial) ^{TotSoil_{comb}} ⁷	RSL (Residential- Direct Contact) ⁸	RSL (Industrial- Direct Contact) ⁸	Soils (Groundwater Protection- Residential) ^{GWSoil_{Ing}} ⁷	Soils (Groundwater Protection- Industrial) ^{GWSoil_{Ing}} ⁷	Soils (Groundwater Protection- Residential) ^{GWSoil_{Class3}} ⁷	Soils (Groundwater Protection- Industrial) ^{GWSoil_{Class3}} ⁷	RSL (Groundwater Protection) ⁹
Aluminum	7429-90-5	SW 6010D/6020B	1.0	2.6E+04	1.8E+04	1.5E+05	3.0E+04	6.4E+04	5.7E+05	7.7E+04	1.1E+06	8.6E+04	2.6E+05	1.0E+06	1.0E+06	2.0E+04
Antimony	7440-36-0	SW 6010D/6020B	0.50	2.0E+00	2.4E+00	8.3E+01	5.0E+00	1.5E+01	3.1E+02	3.1E+01	4.7E+02	2.7E+00	2.7E+00	2.7E+02	2.7E+02	6.0E+00
Arsenic	7440-38-2	SW 6010D/6020B	0.50	9.8E+00	8.2E+00	1.1E+02	1.8E+01	2.4E+01	2.0E+01	6.7E-01	3.0E+00	2.5E+00	2.5E+00	2.5E+02	2.5E+02	5.2E-02
Barium	7440-39-3	SW 6010D/6020B	0.50	NA	1.3E+02	2.3E+04	3.3E+02	8.1E+03	1.2E+05	1.5E+04	2.2E+05	2.2E+02	2.2E+02	2.2E+04	2.2E+04	2.0E+03
Beryllium	7440-41-7	SW 6010D/6020B	0.50	NA	9.2E-01	2.7E+01	1.0E+01	3.8E+01	2.5E+02	1.6E+02	2.3E+03	9.2E-01	9.2E-01	9.2E+01	9.2E+01	4.0E+00
Boron	7440-42-8	SW 6010D/6020B	2.5	NA	NA	1.1E+05	5.0E-01	1.6E+04	1.9E+05	1.6E+04	2.3E+05	NA	NA	NA	NA	4.0E+03
Cadmium	7440-43-9	SW 6010D/6020B	0.50	9.9E-01	1.2E+00	1.1E+03	3.2E+01	5.2E+01	7.6E+02	7.0E+01	9.8E+02	7.5E-01	7.5E-01	7.5E+01	7.5E+01	5.0E+00
Chromium	7440-47-3	SW 6010D/6020B	0.50	4.3E+01	8.1E+01	3.6E+04	4.0E-01	2.7E+04	7.5E+04	1.2E+05	1.8E+06	1.2E+03	1.2E+03	1.2E+05	1.2E+05	2.2E+04
Cobalt	7440-48-4	SW 6010D/6020B	0.50	5.0E+01	1.0E+01	3.2E+04	1.3E+01	3.7E+02	2.0E+03	2.3E+01	3.5E+02	1.1E+02	3.3E+02	1.1E+04	3.3E+04	6.0E+00
Copper	7440-50-8	SW 6010D/6020B	0.50	3.2E+01	3.4E+01	2.1E+04	7.0E+01	1.3E+03	9.4E+04	3.1E+03	4.7E+04	5.2E+02	5.2E+02	5.2E+04	5.2E+04	8.0E+02
Lead	7439-92-1	SW 6010D/6020B	0.50	3.6E+01	4.7E+01	5.0E+02	1.2E+02	5.0E+02	1.6E+03	4.0E+02	8.0E+02	1.5E+00	1.5E+00	1.5E+02	1.5E+02	1.5E+01
Manganese	7439-96-5	SW 6010D/6020B	0.50	4.6E+02	2.6E+02	1.4E+04	2.2E+02	3.8E+03	5.7E+04	1.8E+03	2.6E+04	1.7E+03	5.1E+03	1.7E+05	5.1E+05	4.3E+02
Mercury	7439-97-6	SW 7471B	0.0033	1.8E-01	1.5E-01	3.4E+01	1.0E-01	2.1E+00	3.3E+00	9.4E+00	4.0E+01	3.9E-03	3.9E-03	3.9E-01	3.9E-01	6.3E-01
Nickel	7440-02-0	SW 6010D/6020B	0.50	2.3E+01	2.1E+01	1.4E+03	3.8E+01	8.4E+02	8.6E+03	1.5E+03	2.2E+04	7.9E+01	2.3E+02	7.9E+03	2.3E+04	3.9E+02
Selenium	7782-49-2	SW 6010D/6020B	0.50	NA	1.0E+00	2.7E+03	5.2E-01	3.1E+02	4.9E+03	3.9E+02	5.8E+03	1.1E+00	1.1E+00	1.1E+02	1.1E+02	5.0E+01
Silver	7440-22-4	SW 6010D/6020B	0.50	1.0E+00	1.0E+00	3.5E+02	5.6E+02	9.7E+01	2.3E+03	3.9E+02	5.8E+03	2.4E-01	7.1E-01	2.4E+01	7.1E+01	9.4E+01
Thallium	7440-28-0	SW 6010D/6020B	0.50	NA	NA	4.3E+01	1.0E+00	6.3E+00	7.8E+01	7.8E-01	1.2E+01	8.7E-01	8.7E-01	8.7E+01	8.7E+01	2.0E-01
Vanadium	7440-62-2	SW 6010D/6020B	0.50	NA	5.7E+01	3.3E+02	2.0E+00	7.5E+01	6.1E+02	3.9E+02	5.8E+03	4.4E+02	1.3E+03	4.4E+04	1.3E+05	8.6E+01
Zinc	7440-66-6	SW 6010D/6020B	0.50	1.2E+02	1.5E+02	7.6E+04	1.2E+02	9.9E+03	2.5E+05	2.3E+04	3.5E+05	1.2E+03	3.5E+03	1.2E+05	3.5E+05	6.0E+03

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Sediment Benchmarks, Second Effects Levels, and Benthic PCLs. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Screening Quick Reference Table for Inorganics in Sediment, NOAA 2008.

⁵ ^{TotSed_{comb}} Protective Concentration Level; Texas Risk Reduction Program, March 31, 2006. Screening levels for carcinogens adjusted to 10⁻⁶ risk.

⁶ Soil Benchmarks. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁷ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁸ Regional Screening Levels, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁹ Regional Screening Levels, Lower of Risk-Based or MCL-Based SSL http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 8 - Analyte List and Preliminary Screening Values for Soil and Sediment - Herbicides and Pesticides

Parameter	CAS RN ¹	Method ²	MQL (mg/kg)	Sediment (Ecological Freshwater) ³	Sediment (Ecological Marine) ^{3,4}	Sediment (Human Health) ^{ToxSed_{comb} 5}	Soil (Ecological) ¹⁰	Soils (Human Health- Residential) ^{ToxSoil_{comb} 7}	Soils (Human Health- Industrial) ^{ToxSoil_{comb} 7}	RSL (Residential- Direct Contact) ⁸	RSL (Industrial- Direct Contact) ⁸	Soils (Groundwater Protection- Residential) ^{GWSoil_{Ing} 7}	Soils (Groundwater Protection- Industrial) ^{GWSoil_{Ing} 7}	Soils (Groundwater Protection- Residential) ^{GWSoil_{Class3} 7}	Soils (Groundwater Protection- Industrial) ^{GWSoil_{Class3} 7}	RSL (Groundwater Protection) ⁹
2,4,5-T	93-76-5	SW 8151A	0.0033	NA	NA	1.5E+03	NA	6.7E+02	6.8E+03	6.2E+02	8.2E+03	4.9E-01	1.5E+00	4.9E+01	1.5E+02	6.7E-02
2,4,5-TP (Silvex)	93-72-1	SW 8151A	0.0033	NA	NA	1.2E+03	1.1E-01	5.3E+02	5.5E+03	4.9E+02	6.6E+03	2.6E+00	2.6E+00	2.6E+02	2.6E+02	6.1E-02
2,4-D	94-75-7	SW 8151A	0.0066	NA	NA	2.5E+03	NA	7.3E+02	8.2E+03	6.9E+02	9.7E+03	1.3E+00	1.3E+00	1.3E+02	1.3E+02	4.5E-02
2,4-DB	94-82-6	SW 8151A	0.0066	NA	NA	1.2E+03	NA	5.3E+02	5.5E+03	4.9E+02	6.6E+03	1.9E-01	5.8E-01	1.9E+01	5.8E+01	4.8E-02
4,4'-DDD	72-54-8	SW 8081B	0.0033	4.9E-03	1.2E-03	1.2E+01	7.6E-01	1.4E+00	1.0E+01	2.2E+00	9.6E+00	6.5E-01	1.5E+00	6.5E+02	1.5E+03	7.2E-03
4,4'-DDE	72-55-9	SW 8081B	0.0033	3.2E-03	2.1E-03	8.7E+00	6.0E-01	1.0E+00	7.3E+00	1.6E+00	6.8E+00	5.9E-01	1.3E+00	5.9E+02	1.3E+03	5.4E-02
4,4'-DDT	50-29-3	SW 8081B	0.0033	4.2E-03	1.2E-03	8.7E+00	2.1E-02	5.4E-01	6.8E+00	1.9E+00	8.6E+00	7.4E-01	1.7E+01	7.4E+02	1.7E+03	7.7E-02
a-BHC	319-84-6	SW 8081B	0.0017	6.0E-03	NA	4.1E-01	9.9E-02	2.5E-02	2.9E-01	8.5E-02	3.7E-01	4.0E-04	8.9E-04	4.0E-02	8.9E-02	4.1E-05
Aldrin	309-00-2	SW 8081B	0.0017	2.0E-03	9.5E-03	8.4E-02	3.3E-03	5.0E-03	9.7E-02	3.1E-02	1.4E-01	5.1E-03	1.2E-02	5.1E-01	1.2E+00	7.5E-04
b-BHC	319-85-7	SW 8081B	0.0017	5.0E-03	NA	1.4E+00	4.0E-03	9.2E-02	1.1E+00	3.0E-01	1.3E+00	1.4E-03	3.2E-03	1.4E-01	3.2E-01	1.4E-04
cis-Chlordane	5103-71-9	SW 8081B	0.0017	3.2E-03	2.3E-03	4.1E+00	2.2E-01	1.3E+00	5.4E+00	1.8E+00	8.0E+00	3.7E+01	8.3E+01	3.7E+04	8.3E+04	1.5E-02
Dalapon	75-99-0	SW 8151A	0.0033	NA	NA	4.6E+03	NA	2.0E+03	2.0E+04	1.8E+03	2.5E+04	2.9E-01	2.9E-01	2.9E+01	2.9E+01	1.2E-01
d-BHC	319-86-8	SW 8081B	0.0017	1.3E-01	NA	1.4E+00	9.9E+00	2.9E-01	1.2E+00	3.0E-01	1.3E+00	8.7E-03	1.9E-02	8.7E-01	1.9E+00	1.4E-04
Dicamba	1918-00-9	SW 8151A	0.0033	NA	NA	4.6E+03	NA	2.0E+03	2.0E+04	1.8E+03	2.5E+04	7.3E-01	2.2E+00	7.3E+01	2.2E+02	1.5E-01
Dichloroprop	120-36-5	SW 8151A	0.0066	NA	NA	1.5E+03	NA	6.7E+02	6.8E+03	NA	NA	2.3E-01	7.0E-01	2.3E+01	7.0E+01	NA
Dieldrin	60-57-1	SW 8081B	0.0033	1.9E-03	7.2E-04	8.9E-02	2.2E-02	1.5E-02	1.1E-01	3.3E-02	1.4E-01	2.4E-03	5.5E-03	2.4E-01	5.5E-01	6.9E-05
Dinoseb	88-85-7	SW 8151A	0.0033	NA	NA	1.5E+02	2.2E-02	6.7E+01	6.8E+02	6.2E+01	8.2E+02	1.8E-01	1.8E-01	1.8E+01	1.8E+01	1.3E-01
Endosulfan I	959-98-8	SW 8081B	0.0017	2.9E-03	NA	3.1E+02	1.2E-01	9.1E+01	1.4E+03	3.7E+02	4.9E+03	1.5E+01	4.6E+01	1.5E+03	4.6E+03	1.4E+00
Endosulfan II	33213-65-9	SW 8081B	0.0033	1.4E-02	NA	9.2E+02	1.2E-01	2.7E+02	4.1E+03	3.7E+02	4.9E+03	4.6E+01	1.4E+02	4.6E+03	1.4E+04	1.4E+00
Endosulfan sulfate	1031-07-8	SW 8081B	0.0033	NA	NA	9.2E+02	3.6E-02	3.8E+02	4.1E+03	3.7E+02	4.9E+03	2.3E+03	7.0E+03	2.3E+05	7.0E+05	1.4E+00
Endrin	72-20-8	SW 8081B	0.0033	2.2E-03	2.7E-03	4.6E+01	1.0E-02	9.0E+00	2.0E+02	1.8E+01	2.5E+02	3.8E-01	3.8E-01	3.8E+01	3.8E+01	9.2E-02
Endrin aldehyde	7421-93-4	SW 8081B	0.0033	NA	NA	4.6E+01	1.1E-02	1.9E+01	2.0E+02	1.8E+01	2.5E+02	3.1E+02	9.4E+02	3.1E+04	9.4E+04	9.2E-02
Endrin ketone	53494-70-5	SW 8081B	0.0033	NA	NA	4.6E+01	NA	1.9E+01	2.0E+02	1.8E+01	2.5E+02	2.5E+01	7.6E+01	2.5E+03	7.6E+03	9.2E-02
g-BHC (Lindane)	58-89-9	SW 8081B	0.0017	2.4E-03	3.2E-04	2.0E+00	5.0E-03	1.1E-01	1.8E+00	5.6E-01	2.5E+00	4.6E-03	4.6E-03	4.6E-01	4.6E-01	2.4E-04
Heptachlor	76-44-8	SW 8081B	0.0017	6.0E-04	6.0E-04	3.2E-01	6.0E-03	1.3E-02	2.8E-01	1.2E-01	5.1E-01	9.4E-02	9.4E-02	9.4E+00	9.4E+00	1.6E-04
Heptachlor epoxide	1024-57-3	SW 8081B	0.0017	2.5E-03	6.0E-04	1.6E-01	1.5E-01	2.4E-02	1.9E-01	5.9E-02	2.5E-01	2.9E-02	2.9E-02	2.9E+00	2.9E+00	7.8E-05
MCPA	94-74-6	SW 8151A	0.66	NA	NA	7.7E+01	NA	3.3E+01	3.4E+02	3.1E+01	4.1E+02	1.2E-02	3.5E-02	1.2E+00	3.5E+00	2.0E-03
MCPP	93-65-2	SW 8151A	0.66	NA	NA	1.5E+02	NA	6.7E+01	6.8E+02	6.2E+01	8.2E+02	2.3E-02	7.0E-02	2.3E+00	7.0E+00	4.6E-03
Methoxychlor	72-43-5	SW 8081B	0.017	1.9E-02	NA	7.7E+02	NA	2.7E+02	3.4E+03	3.1E+02	4.1E+03	6.2E+01	6.2E+01	6.2E+03	6.2E+03	2.0E+00
Toxaphene	8001-35-2	SW 8081B	0.017	1.0E-04	1.0E-04	1.3E+00	1.2E-01	1.2E-01	1.7E+00	4.8E-01	2.1E+00	5.8E+00	5.8E+00	5.8E+02	5.8E+02	2.4E-03
trans-Chlordane	5103-74-2	SW 8081B	0.0017	3.2E-03	2.3E-03	4.1E+00	2.2E-01	7.3E-01	5.1E+00	1.8E+00	8.0E+00	2.1E+00	4.6E+00	2.1E+03	4.6E+03	1.5E-02

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Sediment Benchmarks, Second Effects Levels, and Benthic PCLs. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Screening Quick Reference Table for Organics in Sediment and Soil NOAA 2008.

⁵ ^{ToxSed_{comb}} Protective Concentration Level; Texas Risk Reduction Program, March 31, 2006. Screening levels for carcinogens adjusted to 10⁻⁶ risk.

⁶ Soil Benchmarks. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁷ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10⁻⁶ risk.

⁸ Regional Screening Levels, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁹ Regional Screening Levels, Lower of Risk-Based or MCL-Based SSL http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

¹⁰ - EPA Region V Mammals or Plants, USEPA, 2003

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 9 - Analyte List and Preliminary Screening Values for Soil and Sediment - Semivolatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/kg)	Sediment (Ecological Freshwater) ³	Sediment (Ecological Marine) ^{3,4}	Sediment (Human Health) <small>TotSed_{comb}⁵</small>	Soil (Ecological) ^{6,10}	Soils (Human Health- Residential) <small>TotSoil_{comb}⁷</small>	Soils (Human Health- Industrial) <small>TotSoil_{comb}⁷</small>	RSL (Residential- Direct Contact) ⁸	RSL (Industrial- Direct Contact) ⁸	Soils (Groundwater Protection- Residential) <small>GWSoil_{Ing}⁷</small>	Soils (Groundwater Protection- Industrial) <small>GWSoil_{Ing}⁷</small>	Soils (Groundwater Protection- Residential) <small>GWSoil_{Class3}⁷</small>	Soils (Groundwater Protection- Industrial) <small>GWSoil_{Class3}⁷</small>	RSL (Groundwater Protection) ⁹
1,1'-Biphenyl	92-52-4	SW 8270D	0.0066	1.1E+00	7.3E-02	7.7E+03	6.0E+01	1.2E+04	8.5E+04	4.7E+01	2.0E+02	1.3E+03	3.8E+03	1.3E+05	3.8E+05	8.7E-03
1,2,4,5-Tetrachlorobenzene	95-94-3	SW 8270D	0.0066	NA	NA	4.6E+01	2.0E+00	2.0E+01	2.0E+02	1.8E+01	2.5E+02	2.4E-01	7.2E-01	2.4E+01	7.2E+01	7.9E-03
1,4-Dioxane	123-91-1	SW 8270D	0.33	NA	NA	5.0E+02	NA	3.7E+00	1.0E+01	5.3E+00	2.3E+01	8.8E-04	2.0E-03	8.8E-02	2.0E-01	1.6E-04
1-Methylnaphthalene* ^T	90-12-0	SW 8270D	0.0066	NA	NA	8.7E+03	3.2E+00	1.5E+01	6.0E+01	1.7E+01	7.3E+01	1.5E-01	3.3E-01	1.5E+01	3.3E+01	5.8E-03
2,2'-Oxybis(1-chloropropane)	108-60-1	SW 8270D	0.0066	NA	NA	2.0E+01	2.0E+01	4.1E+00	1.1E+01	4.9E+00	2.2E+01	9.5E-03	2.1E-02	9.5E-01	2.1E+00	1.3E-04
2,3,4,6-Tetrachlorophenol	58-90-2	SW 8270D	0.0066	NA	NA	4.6E+03	2.0E-01	1.8E+02	2.0E+04	1.8E+03	2.5E+04	2.2E+00	6.7E+00	2.2E+02	6.7E+02	1.5E+00
2,4,5-Trichlorophenol	95-95-4	SW 8270D	0.0066	NA	3.0E-03	1.5E+04	4.0E+00	6.7E+03	6.8E+04	6.2E+03	8.2E+04	1.7E+01	5.1E+01	1.7E+03	5.1E+03	4.4E+00
2,4,6-Trichlorophenol	88-06-2	SW 8270D	0.0066	NA	6.0E-03	1.3E+02	1.0E+01	6.7E+01	6.8E+02	4.8E+01	2.1E+02	8.7E-02	2.6E-01	8.7E+00	2.6E+01	1.5E-02
2,4-Dichlorophenol	120-83-2	SW 8270D	0.0066	NA	NA	4.6E+02	NA	2.0E+02	2.0E+03	1.8E+02	2.5E+03	1.8E-01	5.3E-01	1.8E+01	5.3E+01	5.4E-02
2,4-Dimethylphenol	105-67-9	SW 8270D	0.0066	NA	1.8E-02	3.1E+03	3.5E+00	1.3E+03	1.4E+04	1.2E+03	1.6E+04	1.6E+00	4.8E+00	1.6E+02	4.8E+02	4.2E-01
2,4-Dinitrophenol	51-28-5	SW 8270D	0.033	NA	NA	3.1E+02	2.0E+01	1.3E+02	1.4E+03	1.2E+02	1.6E+03	4.7E-02	1.4E-01	4.7E+00	1.4E+01	4.4E-02
2,4-Dinitrotoluene	121-14-2	SW 8270D	0.0066	NA	NA	2.1E+00	6.0E+00	6.9E-01	2.8E+00	1.7E+00	7.4E+00	2.7E-04	6.0E-04	2.7E-02	6.0E-02	3.2E-04
2,6-Dinitrotoluene	606-20-2	SW 8270D	0.0066	NA	NA	2.1E+00	5.0E+00	6.9E-01	2.8E+00	3.6E-01	1.5E+00	2.4E-04	5.4E-04	2.4E-02	5.4E-02	6.7E-05
2-Chloronaphthalene	91-58-7	SW 8270D	0.0066	NA	NA	9.9E+03	1.2E-02	5.0E+03	5.0E+04	6.3E+03	9.3E+04	3.3E+02	1.0E+03	3.3E+04	1.0E+05	3.8E+00
2-Chlorophenol	95-57-8	SW 8270D	0.0066	NA	NA	3.7E+03	2.4E-01	4.1E+02	5.1E+03	3.9E+02	5.8E+03	8.2E-01	2.4E+00	8.2E+01	2.4E+02	7.4E-02
2-Methylnaphthalene* ^{L,*T}	91-57-6	SW 8270D	0.0066	2.0E-02	7.0E-02	4.9E+02	3.2E+00	2.5E+02	2.5E+03	2.3E+02	3.0E+03	8.5E+00	2.5E+01	8.5E+02	2.5E+03	1.9E-01
2-Methylphenol (o-Cresol)	95-48-7	SW 8270D	0.0066	5.0E-01	8.0E-03	7.7E+03	4.0E+01	3.3E+03	3.4E+04	3.1E+03	4.1E+04	3.6E+00	1.1E+01	3.6E+02	1.1E+03	7.5E-01
2-Nitroaniline	88-74-4	SW 8270D	0.0066	NA	NA	4.6E+01	7.4E+01	1.1E+01	2.9E+01	6.1E+02	8.0E+03	1.1E-02	3.3E-02	1.1E+00	3.3E+00	8.0E-02
2-Nitrophenol	88-75-5	SW 8270D	0.0066	NA	NA	3.1E+02	1.6E+00	1.3E+02	1.4E+03	NA	NA	6.7E-02	2.0E-01	6.7E+00	2.0E+01	NA
3,3'-Dichlorobenzidine	91-94-1	SW 8270D	0.0066	NA	NA	3.2E+00	6.5E-01	1.0E+00	4.2E+00	1.2E+00	5.1E+00	3.1E-03	7.0E-03	3.1E-01	7.0E-01	8.1E-04
3-Methylphenol (m-Cresol)	108-39-4	SW 8270D	0.0066	5.0E-02	1.0E-01	7.7E+03	3.5E+00	3.3E+03	3.4E+04	3.1E+03	4.1E+04	3.3E+00	9.9E+00	3.3E+02	9.9E+02	7.4E-01
3-Nitroaniline	99-09-2	SW 8270D	0.0066	NA	NA	4.6E+01	3.2E+00	1.2E+01	3.6E+01	NA	NA	1.3E-02	3.8E-02	1.3E+00	3.8E+00	NA
4,6-Dinitro-2-methylphenol	534-52-1	SW 8270D	0.0066	NA	NA	3.1E+02	NA	6.7E+00	6.8E+01	4.9E+00	6.6E+01	2.3E-03	7.0E-03	2.3E-01	7.0E-01	2.6E-03
4-Bromophenyl phenyl ether	101-55-3	SW 8270D	0.0066	1.3E+00	NA	9.5E-02	NA	2.7E-02	1.1E-01	NA	NA	1.8E-02	4.0E-02	1.8E+00	4.0E+00	NA
4-Chloro-3-methylphenol	59-50-7	SW 8270D	0.0066	NA	NA	7.7E+02	8.0E+00	3.3E+02	3.4E+03	6.2E+03	8.2E+04	2.3E+00	6.8E+00	2.3E+02	6.8E+02	1.7E+00
4-Chlorophenyl phenyl ether	7005-72-3	SW 8270D	0.0066	NA	NA	9.5E-02	NA	1.5E-02	8.0E-02	NA	NA	1.6E-03	3.6E-03	1.6E-01	3.6E-01	NA
4-Methylphenol (p-Cresol)	106-44-5	SW 8270D	0.0066	5.0E-02	1.0E-01	7.7E+02	3.5E+00	3.3E+02	3.4E+03	6.2E+03	8.2E+04	3.2E-01	9.4E-01	3.2E+01	9.4E+01	1.5E+00
4-Nitroaniline	100-01-6	SW 8270D	0.033	NA	NA	3.7E+01	2.2E+01	1.9E+02	6.6E+02	2.7E+01	1.2E+02	5.4E-03	1.2E-02	5.4E-01	1.2E+00	1.6E-03
4-Nitrophenol	100-02-7	SW 8270D	0.0066	NA	NA	3.1E+02	7.0E+00	1.3E+02	1.4E+03	NA	NA	5.0E-02	1.5E-01	5.0E+00	1.5E+01	NA
Acenaphthene* ^{L,*T}	83-32-9	SW 8270D	0.0066	6.7E-03	1.6E-02	7.4E+03	2.0E+01	3.0E+03	3.7E+04	3.5E+03	4.5E+04	1.2E+02	3.5E+02	1.2E+04	3.5E+04	5.5E+00
Acenaphthylene* ^{L,*T}	208-96-8	SW 8270D	0.0066	5.9E-03	4.4E-02	7.4E+03	6.8E+02	3.8E+03	3.7E+04	NA	NA	2.0E+02	6.1E+02	2.0E+04	6.1E+04	NA
Acetophenone	98-86-2	SW 8270D	0.0066	NA	NA	1.5E+04	3.0E+02	6.7E+03	6.8E+04	7.8E+03	1.2E+05	4.1E+00	1.2E+01	4.1E+02	1.2E+03	5.8E-01
Anthracene* ^{L,*T}	120-12-7	SW 8270D	0.0066	5.7E-02	8.5E-02	3.7E+04	1.5E+03	1.8E+04	1.9E+05	1.7E+04	2.3E+05	3.4E+03	1.0E+04	3.4E+05	1.0E+06	5.8E+01
Atrazine	1912-24-9	SW 8270D	0.0066	NA	NA	6.4E+00	NA	2.1E+00	8.6E+00	2.3E+00	1.0E+01	1.2E-02	1.2E-02	1.2E+00	1.2E+00	1.9E-04
Benzaldehyde	100-52-7	SW 8270D	0.0066	NA	NA	7.3E+04	2.6E-01	8.2E+03	1.0E+05	7.8E+03	1.2E+05	5.3E+00	1.6E+01	5.3E+02	1.6E+03	4.3E-01
Benzo(a)anthracene* ^{H,*T}	56-55-3	SW 8270D	0.0066	1.1E-01	2.6E-01	1.6E+00	5.2E+00	5.6E-01	2.4E+00	1.5E-01	2.9E+00	8.9E-01	2.0E+00	8.9E+02	2.0E+03	1.2E-02
Benzo(a)pyrene* ^{H,*T}	50-32-8	SW 8270D	0.0066	1.5E-01	4.3E-01	1.6E-01	1.5E+00	5.6E-02	2.4E-01	1.5E-02	2.9E-01	3.8E+00	3.8E+00	3.8E+02	3.8E+02	4.0E-03
Benzo(b)fluoranthene* ^T	205-99-2	SW 8270D	0.0066	NA	1.1E+00	1.6E+00	6.0E+01	5.7E-01	2.4E+00	1.5E-01	2.9E+00	3.0E+00	6.7E+01	3.0E+03	6.7E+03	4.1E-02
Benzo(ghi)perylene* ^T	191-24-2	SW 8270D	0.0066	1.7E-01	5.0E-01	3.7E+03	1.2E+02	1.8E+03	1.9E+04	NA	NA	2.3E+04	6.9E+04	1.0E+06	1.0E+06	NA
Benzo(k)fluoranthene* ^T	207-08-9	SW 8270D	0.0066	2.4E-01	5.4E-01	1.6E+01	1.5E+02	5.7E+00	2.4E+01	1.5E+00	2.9E+01	3.1E+02	6.9E+02	3.1E+04	6.9E+04	4.0E-01
bis(2-Chloroethoxy)methane	111-91-1	SW 8270D	0.0066	NA	NA	1.3E+00	3.0E-01	2.5E-01	6.2E-01	1.8E+02	2.5E+03	5.9E-04	1.3E-03	5.9E-02	1.3E-01	1.3E-02
bis(2-Chloroethyl)ether	111-44-4	SW 8270D	0.0066	NA	NA	5.0E+00	2.4E+01	1.4E-01	2.8E-01	2.3E-01	1.0E+00	1.1E-04	2.4E-04	1.1E-02	2.4E-02	3.6E-06
bis(2-Ethylhexyl)phthalate	117-81-7	SW 8270D	0.0066	1.8E-01	1.8E-01	2.4E+01	9.3E-01	4.3E+00	5.6E+01	3.8E+01	1.6E+02	8.2E+01	8.2E+01	8.2E+03	8.2E+03	1.3E+00
Butyl benzyl phthalate	85-68-7	SW 8270D	0.0066	1.1E+01	NA	3.1E+04	2.4E-01	1.6E+02	1.0E+03	2.8E+02	1.2E+03	1.3E+01	3.0E+01	1.3E+04	3.0E+04	2.3E-01
Caprolactam	105-60-2	SW 8270D	0.0066	NA	NA	7.7E+04	2.6E-01	3.3E+04	3.4E+05	3.1E+04	4.0E+05	2.3E+01	7.0E+01	2.3E+03	7.0E+03	2.5E+00
Carbazole	86-74-8	SW 8270D	0.0066	NA	NA	7.1E+01	9.9E-02	2.3E+01	9.5E+01	NA	NA	2.3E-01	5.1E-01	2.3E+02	5.1E+02	NA
Chrysene* ^{H,*T}	218-01-9	SW 8270D	0.0066	1.7E-01	3.8E-01	1.6E+02	4.7E+00	5.6E+01	2.4E+02	1.5E+01	2.9E+02	7.7E+02	1.7E+03	7.7E+04	1.7E+05	1.2E+00

Table 9 - Analyte List and Preliminary Screening Values for Soil and Sediment - Semivolatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/kg)	Sediment (Ecological Freshwater) ³	Sediment (Ecological Marine) ^{3,4}	Sediment (Human Health) <small>TotSed_{comb}</small> ⁵	Soil (Ecological) ^{6,10}	Soils (Human Health- Residential) <small>TotSoil_{comb}</small> ⁷	Soils (Human Health- Industrial) <small>TotSoil_{comb}</small> ⁷	RSL (Residential- Direct Contact) ⁸	RSL (Industrial- Direct Contact) ⁸	Soils (Groundwater Protection- Residential) <small>GWSoil_{Ing}</small> ⁷	Soils (Groundwater Protection- Industrial) <small>GWSoil_{Ing}</small> ⁷	Soils (Groundwater Protection- Residential) <small>GWSoil_{Class3}</small> ⁷	Soils (Groundwater Protection- Industrial) <small>GWSoil_{Class3}</small> ⁷	RSL (Groundwater Protection) ⁹
Dibenz(a,h)anthracene* ^H * ^T	53-70-3	SW 8270D	0.0066	3.3E-02	6.3E-02	1.6E-01	1.8E+01	5.5E-02	2.4E-01	1.5E-02	2.9E-01	4.8E-01	1.1E+00	4.8E+02	1.1E+03	1.3E-02
Dibenzofuran	132-64-9	SW 8270D	0.0066	5.1E+00	1.1E-01	6.1E+02	9.9E-02	2.7E+02	2.7E+03	7.2E+01	1.0E+03	1.7E+01	5.0E+01	1.7E+03	5.0E+03	1.5E-01
Diethyl phthalate	84-66-2	SW 8270D	0.0066	6.3E-01	NA	1.2E+05	1.0E+02	5.3E+04	5.5E+05	4.9E+04	6.6E+05	7.8E+01	2.3E+02	7.8E+03	2.3E+04	6.1E+00
Dimethyl phthalate	131-11-3	SW 8270D	0.0066	NA	6.0E-03	1.2E+05	2.0E+02	5.3E+04	5.5E+05	NA	NA	3.1E+01	9.3E+01	3.1E+03	9.3E+03	NA
Di-n-butyl phthalate	84-74-2	SW 8270D	0.0066	3.8E-01	2.2E+00	1.5E+04	2.0E+02	6.2E+03	6.8E+04	6.2E+03	8.2E+04	1.7E+03	5.0E+03	1.7E+05	5.0E+05	2.3E+00
Di-n-octyl phthalate	117-84-0	SW 8270D	0.0066	NA	6.1E-02	3.1E+03	7.1E+02	6.4E+02	6.8E+03	6.2E+02	8.2E+03	4.1E+05	1.0E+06	1.0E+06	1.0E+06	5.7E+01
Fluoranthene* ^H * ^T	206-44-0	SW 8270D	0.0066	4.2E-01	6.0E-01	4.9E+03	1.2E+02	2.3E+03	2.5E+04	2.3E+03	3.0E+04	9.6E+02	2.9E+03	9.6E+04	2.9E+05	8.9E+01
Fluorene* ^L * ^T	86-73-7	SW 8270D	0.0066	7.7E-02	1.9E-02	4.9E+03	3.0E+01	2.3E+03	2.5E+04	2.3E+03	3.0E+04	1.5E+02	4.5E+02	1.5E+04	4.5E+04	5.4E+00
Hexachlorobenzene	118-74-1	SW 8270D	0.0066	2.0E-02	6.0E-03	8.9E-01	2.0E-01	1.0E-01	6.9E-01	3.3E-01	1.4E+00	5.6E-01	5.6E-01	5.6E+01	5.6E+01	6.1E-04
Hexachlorobutadiene	87-68-3	SW 8270D	0.0066	5.5E-02	2.0E-02	3.1E+01	4.0E-02	1.2E+00	2.3E+00	6.8E+00	3.0E+01	1.6E-01	3.7E-01	1.6E+01	3.7E+02	5.7E-04
Hexachlorocyclopentadiene	77-47-4	SW 8270D	0.0066	NA	NA	9.2E+02	1.0E+01	7.2E+00	1.0E+01	3.7E+02	4.9E+03	9.6E+00	9.6E+00	9.6E+02	9.6E+02	9.6E-02
Hexachloroethane	67-72-1	SW 8270D	0.0066	2.3E-01	1.8E-01	1.5E+02	6.0E-01	4.6E+01	4.2E+02	1.3E+01	5.8E+01	6.4E-01	1.9E+00	6.4E+01	1.9E+02	5.5E-04
Indeno(1,2,3-cd)pyrene* ^T	193-39-5	SW 8270D	0.0066	2.0E-01	4.9E-01	1.6E+00	1.1E+02	5.7E-01	2.4E+00	1.5E-01	2.9E+00	8.7E+00	1.9E+01	8.7E+03	1.9E+04	2.4E-01
Isophorone	78-59-1	SW 8270D	0.0066	NA	NA	1.5E+03	1.4E+02	4.9E+02	2.0E+03	5.6E+02	2.4E+03	1.5E-01	3.4E-01	1.5E+01	3.4E+01	2.6E-02
Naphthalene* ^L * ^T	91-20-3	SW 8270D	0.0066	1.8E-01	1.6E-01	2.5E+03	9.9E-02	1.2E+02	1.9E+02	3.8E+00	1.7E+01	1.6E+01	4.7E+01	1.6E+03	4.7E+03	5.4E-04
Nitrobenzene	98-95-3	SW 8270D	0.0066	5.1E-01	1.3E-01	7.7E+01	4.0E+01	3.4E+00	5.7E+00	5.1E+00	2.2E+01	1.8E-01	5.2E-01	1.8E+01	5.2E+01	9.2E-05
N-Nitrosodi-n-propylamine	621-64-7	SW 8270D	0.0066	NA	NA	6.3E-02	5.4E-01	4.0E-02	1.4E-01	7.6E-02	3.3E-01	1.8E-05	3.9E-05	1.8E-03	3.9E-03	8.1E-06
N-Nitrosodiphenylamine	86-30-6	SW 8270D	0.0066	NA	2.8E-02	9.0E+01	2.0E+01	5.7E+01	1.9E+02	1.1E+02	4.7E+02	1.4E-01	3.2E-01	1.4E+01	3.2E+02	6.6E-02
Pentachlorophenol	87-86-5	SW 8270D	0.0066	NA	1.7E-02	5.6E+00	5.0E+00	7.3E-02	3.2E+00	9.9E-01	4.0E+00	9.2E-03	9.2E-03	9.2E-01	9.2E-01	4.0E-04
Phenanthrene* ^L * ^T	85-01-8	SW 8270D	0.0066	2.0E-01	2.4E-01	3.7E+03	4.6E+01	1.7E+03	1.9E+04	NA	NA	2.1E+02	6.2E+02	2.1E+04	6.2E+04	NA
Phenol	108-95-2	SW 8270D	0.0066	4.8E-02	1.3E-01	4.6E+04	3.0E+01	2.0E+04	2.0E+05	1.8E+04	2.5E+05	9.6E+00	2.9E+01	9.6E+02	2.9E+03	3.3E+00
Pyrene* ^H * ^T	129-00-0	SW 8270D	0.0066	2.0E-01	6.7E-01	3.7E+03	7.9E+01	1.7E+03	1.9E+04	1.7E+03	2.3E+04	5.6E+02	1.7E+03	5.6E+04	1.7E+05	1.3E+01
High Molecular Weight PAHs	HMWPAH	SW 8270D	0.0066	NA	1.7E+00	NA	1.8E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Low Molecular Weight PAHs	LMWPAH	SW 8270D	0.0066	NA	5.5E-01	NA	2.9E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PAHs	TPAH	SW 8270D	0.0066	1.6E+00	4.0E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Sediment Benchmarks, Second Effects Levels, and Benthic PCLs. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Screening Quick Reference Table for Organics in Sediment and Soil NOAA 2008.

⁵ TotSed_{comb} Protective Concentration Level; Texas Risk Reduction Program, March 31, 2006. Screening levels for carcinogens adjusted to 10⁻⁶ risk.

⁶ Soil Benchmarks. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁷ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10-6 risk.

⁸ Regional Screening Levels, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁹ Regional Screening Levels, Lower of Risk-Based or MCL-Based SSL. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

¹⁰ - EPA Region V Mammals or Plants, USEPA, 2003

MQL - Method Quantitation Limit

NA – Not Available

*^T - These compounds are summed to provide the concentration of Total Polynuclear Aromatic Hydrocarbons (PAHs).

*^L - Low Molecular Weight PAH compound.

*^H - High Molecular Weight PAH compound.

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 10 - Analyte List and Preliminary Screening Values for Soil and Sediment - Volatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/kg)	Sediment (Ecological Freshwater) ³	Sediment (Ecological Marine) ³	Sediment (Human Health) TotSed _{comb} ⁵	Soil (Ecological) ^{6,10}	Soils (Human Health- Residential) TotSoil _{comb} ⁷	Soils (Human Health- Industrial) TotSoil _{comb} ⁷	RSL (Residential- Direct Contact) ⁸	RSL (Industrial- Direct Contact) ⁸	Soils (Groundwater Protection- Residential) GWSoil _{Ing} ⁷	Soils (Groundwater Protection- Industrial) GWSoil _{Ing} ⁷	Soils (Groundwater Protection- Residential) GWSoil _{Class3} ⁷	Soils (Groundwater Protection- Industrial) GWSoil _{Class3} ⁷	RSL (Groundwater Protection) ⁹
1,1,1,2-Tetrachloroethane	630-20-6	SW 8260B	0.0050	NA	NA	2.1E+02	2.3E+02	3.9E+00	7.3E+00	2.0E+00	8.8E+00	7.1E-02	1.6E-01	7.1E+00	1.6E+01	2.2E-04
1,1,1-Trichloroethane	71-55-6	SW 8260B	0.0050	4.1E+00	2.6E+00	1.5E+05	3.0E+01	3.2E+04	5.5E+04	8.1E+03	3.6E+04	8.1E-01	8.1E-01	8.1E+01	8.1E+01	2.8E+00
1,1,2,2-Tetrachloroethane	79-34-5	SW 8260B	0.0050	6.3E-01	6.1E-01	2.7E+01	1.3E-01	3.0E+00	1.4E+01	6.0E-01	2.7E+00	1.2E-03	2.6E-03	1.2E-01	2.6E-01	3.0E-05
1,1,2-Trichloroethane	79-00-5	SW 8260B	0.0050	9.8E-01	3.0E-01	9.6E+01	2.9E+01	1.0E+00	1.9E+00	1.1E+00	5.0E+00	1.0E-02	1.0E-02	1.0E+00	1.0E+00	8.9E-05
1,1,2-Trichlorotrifluoroethane	76-13-1	SW 8260B	0.0050	2.8E+00	NA	1.0E+06	NA	2.2E+05	3.3E+05	4.0E+04	1.7E+05	4.0E+04	1.2E+05	1.0E+06	1.0E+06	1.4E+02
1,1-Dichloroethane	75-34-3	SW 8260B	0.0050	2.3E+00	NA	7.3E+04	2.0E+01	8.8E+03	2.3E+04	3.6E+00	1.6E+01	9.2E+00	2.8E+01	9.2E+02	2.8E+03	7.8E-04
1,1-Dichloroethene	75-35-4	SW 8260B	0.0050	1.9E+00	1.5E+01	3.7E+04	8.3E+00	1.6E+03	3.5E+03	2.3E+02	1.0E+03	2.5E-02	2.5E-02	2.5E+00	2.5E+00	1.0E-01
1,2,3-Trichlorobenzene	87-61-6	SW 8260B	0.0050	NA	NA	4.6E+02	2.0E+01	8.7E+01	2.0E+02	4.9E+01	6.6E+02	1.3E+01	3.9E+01	1.3E+03	3.9E+03	2.1E-02
1,2,4-Trichlorobenzene	120-82-1	SW 8260B	0.0050	8.8E-01	3.9E-01	1.5E+03	2.0E+01	7.0E+01	1.1E+02	2.4E+01	1.1E+02	2.4E+00	2.4E+00	2.4E+02	2.4E+02	3.3E-03
1,2,4-Trimethylbenzene	95-63-6	SW 8260B	0.0050	7.6E-01	2.2E+00	3.7E+04	NA	7.9E+01	1.1E+02	5.8E+01	2.4E+02	2.4E+01	7.2E+01	2.4E+03	7.2E+03	2.1E-02
1,2-Dibromoethane	106-93-4	SW 8260B	0.0050	NA	NA	2.7E+00	1.2E+00	4.3E-02	7.9E-02	3.6E-02	1.6E-01	1.0E-04	1.0E-04	1.0E-02	1.0E-02	2.1E-06
1,2-Dichlorobenzene	95-50-1	SW 8260B	0.0050	8.3E-01	7.4E-01	6.6E+04	3.0E+00	3.9E+02	5.7E+02	1.8E+03	9.3E+03	8.9E+00	8.9E+00	8.9E+02	8.9E+02	3.0E-01
1,2-Dichloroethane	107-06-2	SW 8260B	0.0050	4.8E+00	4.3E+00	6.0E+01	2.1E+01	6.4E-01	1.1E+00	4.6E-01	2.0E+00	6.9E-03	6.9E-03	6.9E-01	6.9E-01	4.8E-05
1,2-Dichloropropane	78-87-5	SW 8260B	0.0050	2.2E+00	2.8E+00	8.0E+01	7.0E+02	3.1E+01	4.4E+01	1.0E+00	4.4E+00	1.1E-02	1.1E-02	1.1E+00	1.1E+00	1.5E-04
1,3,5-Trimethylbenzene	108-67-8	SW 8260B	0.0050	7.7E-01	NA	3.7E+04	2.6E-01	5.9E+01	8.3E+01	7.8E+02	1.2E+04	2.7E+01	7.9E+01	2.7E+03	7.9E+03	1.7E-01
1,3-Dichlorobenzene	541-73-1	SW 8260B	0.0050	1.9E-01	3.2E-01	2.2E+04	3.8E+01	6.2E+01	8.8E+01	NA	NA	3.4E+00	1.0E+01	3.4E+02	1.0E+03	NA
1,4-Dichlorobenzene	106-46-7	SW 8260B	0.0050	7.7E-01	7.0E-01	2.3E+02	2.0E+01	2.5E+01	1.2E+02	2.6E+00	1.1E+01	1.1E+00	1.1E+00	1.1E+02	1.1E+02	4.6E-04
2-Butanone (MEK)	78-93-3	SW 8260B	0.010	2.6E+01	NA	4.4E+05	9.0E+01	3.3E+04	1.2E+05	2.7E+04	1.9E+05	1.5E+01	4.4E+01	1.5E+03	4.4E+03	1.2E+00
2-Hexanone	591-78-6	SW 8260B	0.010	4.7E+00	NA	4.4E+04	1.3E+01	2.1E+02	5.3E+02	2.0E+02	1.3E+03	1.6E-01	4.8E-01	1.6E+01	4.8E+01	8.8E-03
4-Methyl-2-pentanone	108-10-1	SW 8260B	0.010	1.9E+01	4.5E+01	5.9E+04	NA	5.4E+03	2.8E+04	5.3E+03	5.6E+04	2.5E+00	7.4E+00	2.5E+02	7.4E+02	2.8E-01
Acetone	67-64-1	SW 8260B	0.020	6.0E+01	1.7E+02	6.6E+05	2.5E+00	5.9E+04	2.9E+05	6.1E+04	6.7E+05	2.1E+01	6.4E+01	2.1E+03	6.4E+03	2.9E+00
Benzene	71-43-2	SW 8260B	0.0050	1.6E-01	1.4E-01	9.9E+01	2.6E-01	6.9E+00	1.3E+01	1.2E+00	5.1E+00	1.3E-02	1.3E-02	1.3E+00	1.3E+00	2.3E-04
Bromodichloromethane	75-27-4	SW 8260B	0.0050	2.5E+00	NA	8.8E+01	5.4E-01	9.8E+00	4.6E+01	2.9E-01	1.3E+00	3.3E-03	7.3E-03	3.3E-01	7.3E-01	3.6E-05
Bromoform	75-25-2	SW 8260B	0.0050	2.2E-01	1.8E+00	6.9E+02	1.6E+01	2.8E+01	6.0E+01	6.7E+01	2.9E+02	3.2E-02	7.1E-02	3.2E+00	7.1E+00	2.4E-03
Bromomethane	74-83-9	SW 8260B	0.010	8.0E-02	4.2E-01	1.0E+03	2.4E-01	2.9E+01	5.3E+01	6.8E+00	3.0E+01	6.5E-02	2.0E-01	6.5E+00	2.0E+01	1.9E-03
Carbon disulfide	75-15-0	SW 8260B	0.010	1.2E-01	NA	7.3E+04	9.4E-02	3.3E+03	7.2E+03	7.7E+02	3.5E+03	6.8E+00	2.0E+01	6.8E+02	2.0E+03	2.4E-01
Carbon tetrachloride	56-23-5	SW 8260B	0.0050	2.0E-02	3.7E+00	4.2E+01	3.0E+00	2.3E+00	4.6E+00	6.5E-01	2.9E+00	3.1E-02	3.1E-02	3.1E+00	3.1E+00	1.8E-04
Chlorobenzene	108-90-7	SW 8260B	0.0050	1.7E-01	2.9E-01	1.5E+04	4.0E+01	3.2E+02	5.4E+02	2.8E+02	1.3E+03	5.5E-01	5.5E-01	5.5E+01	5.5E+01	5.3E-02
Chloroethane	75-00-3	SW 8260B	0.010	NA	NA	2.9E+05	NA	2.3E+04	8.7E+04	1.4E+04	5.7E+04	1.5E+01	4.6E+01	1.5E+03	4.6E+03	5.9E+00
Chloroform	67-66-3	SW 8260B	0.0050	9.4E-01	4.3E+00	7.3E+03	1.2E+00	8.0E-01	1.3E+00	3.2E-01	1.4E+00	5.1E-01	1.5E+00	5.1E+01	1.5E+02	6.1E-05
Chloromethane	74-87-3	SW 8260B	0.010	1.8E+01	8.7E+00	4.2E+02	1.0E+01	8.4E+00	1.6E+01	1.1E+02	4.6E+02	2.0E-02	4.5E-02	2.0E+00	4.5E+00	4.9E-02
cis -1,2-Dichloroethene	156-59-2	SW 8260B	0.0050	NA	NA	7.3E+03	NA	1.2E+02	5.0E+02	1.6E+02	2.3E+03	1.2E-01	1.2E-01	1.2E+01	1.2E+01	1.1E-02
cis -1,3-Dichloropropene	10061-01-5	SW 8260B	0.0050	2.3E-01	4.0E-02	7.3E+01	4.0E-01	7.8E+00	5.3E+00	1.8E+00	8.2E+00	3.3E-04	7.4E-04	3.3E-02	7.4E-02	1.7E-04
Cyclohexane	110-82-7	SW 8260B	0.0050	NA	NA	1.0E+06	NA	4.2E+04	6.5E+04	6.5E+03	2.7E+04	2.9E+03	8.8E+03	2.9E+05	8.8E+05	1.3E+01
Dibromochloromethane	124-48-1	SW 8260B	0.0050	1.6E-01	NA	6.5E+01	2.1E+00	7.2E+00	3.4E+01	7.3E-01	3.2E+00	2.5E-03	5.5E-03	2.5E-01	5.5E-01	4.5E-05
Dichlorodifluoromethane	75-71-8	SW 8260B	0.0050	3.7E+00	NA	1.5E+05	4.0E+01	7.5E+02	1.1E+03	8.7E+01	3.7E+02	1.2E+02	3.6E+02	1.2E+04	3.6E+04	3.0E-01
Ethylbenzene	100-41-4	SW 8260B	0.0050	2.9E+00	6.5E-01	7.3E+04	5.2E+00	5.3E+03	1.7E+04	5.8E+00	2.5E+01	3.8E+00	3.8E+00	3.8E+02	3.8E+02	1.7E-03
Isopropylbenzene (Cumene)	98-82-8	SW 8260B	0.0050	9.0E+00	NA	7.3E+04	NA	3.0E+03	6.3E+03	1.9E+03	9.9E+03	1.7E+02	5.2E+02	1.7E+04	5.2E+04	7.4E-01
Methyl acetate	79-20-9	SW 8260B	0.0050	NA	NA	7.3E+05	NA	8.2E+04	1.0E+06	7.8E+04	1.2E+06	2.4E+01	7.3E+01	2.4E+03	7.3E+03	4.1E+00
Methyl tert-butyl ether	1634-04-4	SW 8260B	0.0050	NA	NA	7.3E+03	NA	5.9E+01	1.1E+02	4.7E+01	2.1E+02	3.1E-01	9.3E-01	3.1E+01	9.3E+01	3.2E-03
Methylcyclohexane	108-87-2	SW 8260B	0.0050	NA	NA	1.0E+06	NA	2.2E+04	3.3E+04	NA	NA	7.8E+03	2.3E+04	7.8E+05	1.0E+06	NA
Methylene chloride	75-09-2	SW 8260B	0.010	7.8E+00	3.8E+00	7.3E+02	4.1E+00	1.5E+03	8.6E+03	5.7E+01	1.0E+03	6.5E-03	6.5E-03	6.5E-01	6.5E-01	2.9E-03
n-Butylbenzene	104-51-8	SW 8260B	0.0050	1.1E+00	NA	6.1E+03	NA	3.3E+03	3.4E+04	3.9E+03	5.8E+04	7.6E+01	2.3E+02	7.6E+03	2.3E+04	3.2E+00
n-Propylbenzene	103-65-1	SW 8260B	0.0050	7.2E-01	NA	2.9E+04	NA	1.6E+03	4.1E+03	3.3E+03	2.2E+04	2.2E+01	6.7E+01	2.2E+03	6.7E+03	1.2E+00

Table 10 - Analyte List and Preliminary Screening Values for Soil and Sediment - Volatile Organic Compounds

Parameter	CAS RN ¹	Method ²	MQL (mg/kg)	Sediment (Ecological Freshwater) ³	Sediment (Ecological Marine) ³	Sediment (Human Health) ^{TotSed_{comb}} ⁵	Soil (Ecological) ^{6,10}	Soils (Human Health- Residential) ^{TotSoil_{comb}} ⁷	Soils (Human Health- Industrial) ^{TotSoil_{comb}} ⁷	RSL (Residential- Direct Contact) ⁸	RSL (Industrial- Direct Contact) ⁸	Soils (Groundwater Protection- Residential) ^{GWSoil_{Ing}} ⁷	Soils (Groundwater Protection- Industrial) ^{GWSoil_{Ing}} ⁷	Soils (Groundwater Protection- Residential) ^{GWSoil_{Class3}} ⁷	Soils (Groundwater Protection- Industrial) ^{GWSoil_{Class3}} ⁷	RSL (Groundwater Protection) ⁹
sec-Butylbenzene	135-98-8	SW 8260B	0.0050	8.8E-01	NA	2.9E+04	NA	3.3E+03	4.1E+04	7.8E+03	1.2E+05	4.2E+01	1.3E+02	4.2E+03	1.3E+04	5.9E+00
Styrene	100-42-5	SW 8260B	0.0050	1.0E+01	3.7E+00	1.5E+05	3.0E+02	4.3E+03	7.8E+03	6.0E+03	3.5E+04	1.6E+00	1.6E+00	1.6E+02	1.6E+02	1.3E+00
tert-Butylbenzene	98-06-6	SW 8260B	0.0050	1.2E+00	NA	2.9E+04	NA	3.3E+03	4.1E+04	7.8E+03	1.2E+05	5.0E+01	1.5E+02	5.0E+03	1.5E+04	1.6E+00
Tetrachloroethene	127-18-4	SW 8260B	0.0050	1.7E+00	3.1E+00	1.0E+02	9.9E+00	4.2E+01	7.7E+01	2.4E+01	1.0E+02	2.5E-02	2.5E-02	2.5E+00	2.5E+00	5.1E-03
Toluene	108-88-3	SW 8260B	0.0050	2.9E+00	9.4E-01	5.9E+04	2.0E+02	5.4E+03	2.9E+04	4.9E+03	4.7E+04	4.1E+00	4.1E+00	4.1E+02	4.1E+02	7.6E-01
trans -1,2-Dichloroethene	156-60-5	SW 8260B	0.0050	2.4E+01	NA	1.5E+04	7.8E-01	3.7E+02	6.4E+02	1.6E+03	2.3E+04	2.5E-01	2.5E-01	2.5E+01	2.5E+01	1.1E-01
trans -1,3-Dichloropropene	10061-02-6	SW 8260B	0.0050	2.3E-01	4.0E-02	5.4E+01	4.0E-01	2.6E+00	6.1E+00	1.8E+00	8.2E+00	1.8E-03	4.0E-03	1.8E-01	4.0E-01	1.7E-04
Trichloroethene	79-01-6	SW 8260B	0.0050	8.4E-01	1.5E+00	4.4E+03	1.2E+01	1.1E+01	2.1E+01	9.4E-01	6.0E+00	1.7E-02	1.7E-02	1.7E+00	1.7E+00	1.8E-04
Trichlorofluoromethane	75-69-4	SW 8260B	0.0050	1.7E+00	NA	2.2E+05	1.6E+01	2.5E+04	3.1E+05	7.3E+02	3.1E+03	6.4E+01	1.9E+02	6.4E+03	1.9E+04	7.3E-01
Vinyl chloride	75-01-4	SW 8260B	0.0020	2.0E+00	NA	3.6E+00	6.5E-01	3.4E-01	1.3E+00	5.9E-02	1.7E+00	1.1E-02	1.1E-02	1.1E+00	1.1E+00	6.5E-06
Xylenes, total	1330-20-7	SW 8260B	0.01500	4.0E+00	2.5E+00	1.5E+05	1.0E+01	3.7E+03	6.5E+03	5.8E+02	2.5E+03	6.1E+01	6.1E+01	6.1E+03	6.1E+03	1.9E-01

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Sediment Benchmarks, Second Effects Levels, and Benthic PCLs. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ Screening Quick Reference Table for Organics in Sediment and Soil NOAA 2008

⁵ ^{TotSed_{comb}} Protective Concentration Level; Texas Risk Reduction Program, March 31, 2006. Screening levels for carcinogens adjusted to 10⁶ risk.

⁶ Soil Benchmarks. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁷ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10⁻⁶ risk.

⁸ Regional Screening Levels, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

⁹ Regional Screening Levels, Lower of Risk-Based or MCL-Based SSL http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

¹⁰ - EPA Region V Mammals or Plants, USEPA, 2003

MQL - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 11 - Analyte List and Preliminary Screening Values for Soil and Sediment - Total Petroleum Hydrocarbons

Parameter	CAS RN ¹	Method ²	MLQ (mg/kg)	Sediment (Ecological Freshwater) ³	Sediment (Ecological Marine) ³	Sediment (Human Health) TotSed _{comb} ⁴	Soil (Ecological) ⁵	Soils (Human Health- Residential) TotSoil _{comb} ⁶	Soils (Human Health- Industrial) TotSoil _{comb} ⁶	RSL (Direct Contact Residential) ⁷	RSL (Direct Contact Industrial) ⁷	Soils (Groundwater Protection- Residential) ⁶ GWSoil _{Ing}	Soils (Groundwater Protection- Industrial) GWSoil _{Ing} ⁶	Soils (Groundwater Protection- Residential) GWSoil _{Class3} ⁶	Soils (Groundwater Protection- Industrial) GWSoil _{Class3} ⁶	RSL (Groundwater Protection) ⁸
C6 - C12	TPH-1005-1	TX1005	25	NA	NA	4.4E+04	NA	1.1E+03	2.1E+03	8.2E+01	4.2E+02	3.3E+01	9.7E+01	3.3E+03	9.7E+03	3.3E+01
>C12 - C28	TPH-1005-2	TX1005	25	NA	NA	1.5E+04	NA	2.0E+03	7.8E+03	9.6E+01	4.4E+02	9.9E+01	3.0E+02	9.9E+03	3.0E+04	1.0E+02
>C12 - C35	TPH-1005-3	TX1005	25	NA	NA	NA	NA	2.0E+03	7.8E+03	2.5E+03	3.3E+04	9.9E+01	3.0E+02	9.9E+03	3.0E+04	8.0E+02
>C28 - C35	TPH-1005-4	TX1005	25	NA	NA	NA	NA	2.0E+03	7.8E+03	2.3E+05	3.5E+06	9.9E+01	3.0E+02	9.9E+03	3.0E+04	6.0E+04

¹ Chemical Abstracts Service Registry Number

² SW: USEPA 1986

³ Sediment Benchmarks, Second Effects Levels, and Benthic PCLs. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁴ TotSed_{comb} Protective Concentration Level; Texas Risk Reduction Program, March 31, 2006. Screening levels for carcinogens adjusted to 10⁶ risk.

⁵ Soil Benchmarks. August 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>

⁶ Protective Concentration Level; Texas Risk Reduction Program, November 12, 2014. <http://www.tceq.state.tx.us/remediation/trrp/trrppcls.html>. Screening levels for carcinogens adjusted to 10⁻⁶ risk.

⁷ Regional Screening Levels, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, May 2014.

⁸ Regional Screening Levels, Lower of Risk-Based or MCL-Based SSL http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, January 2015.

MLQ - Method Quantitation Limit

NA – Not Available

Preliminary Screening Values (PSVs) are provided to aid in decision-making and are not cleanup criteria. PSVs will be updated as needed for the human health and ecological risk assessments.

Table 12 – Summary of Field Measurements

Field Measurement	Standard Operating Procedure (SOP)¹
Soil Lithology	PBW SOP No. 2: Supervision of Exploratory Borings
Soil Headspace Screening (Organic Vapors)	PBW SOP No. 3 Field Organic Vapor Screening Methodology For Soil Samples
Monitoring Well Water Level/NAPL Presence	PBW SOP No. 9 Water Level, Immiscible Layer And Well Depth Measurement
Groundwater Parameters (Temperature, Specific Conductance, pH, Dissolved Oxygen, Oxidation/Reduction Potential, Turbidity and Ferrous Iron)	PBW SOP No. 10 Water Quality Sampling
Single-well Slug Test	PBW SOP No. 15 Hydraulic Testing

¹ – SOPs are included in Field Sampling Plan (FSP)

Table 13 – Fate and Transport Analytical Protocols

Parameter	CAS RN¹	Method²	MQL	Data Objective
Bulk Density	Not Applicable	ASTM D2937	Not applicable	USOR Property-specific calculation of COPC leaching from soil to groundwater
Chloride	16887-00-6	SW 9056A	0.5 mg/L	USOR Property-specific adjustment of freshwater ecological benchmark for silver
Grain Size	Not Applicable	ASTM D422	Not applicable	USOR Property-specific calculation of COPC leaching from soil to groundwater
Hardness	Not Applicable	SW 6010D/6020B	0.005 mg/L	USOR Property-specific adjustment of freshwater ecological benchmarks for arsenic, cadmium, chromium, copper, lead, nickel, zinc
Moisture (Soil)	Not Applicable	MCAWW 160.3	0.1 percent	Dry weight correction of soil and sediment samples
pH (soil)	Not Applicable	SW 9045C	0.1 unit	USOR Property-specific adjustment of screening values for Kd-dependent metals
Salinity	Not Applicable	SM 2520B	0.01 salinity units	Differentiation between freshwater and marine water for selection of ecological screening benchmarks
Total Dissolved Solids	Not Applicable	MCAWW 160.1	10 mg/L	Groundwater classification
Total Organic Carbon	Not Applicable	Walkley-Black ⁴	100 mg/Kg	USOR Property-specific adjustment of screening values for organic carbon dependent organics
Fraction Organic Carbon	Not Applicable	See Total Organic Carbon	1.0E-04 gram/gram	USOR Property-specific adjustment of screening values for organic carbon dependent organics; convert total organic carbon to fraction organic carbon by dividing by 1,000,000
Total Suspended Solids	Not Applicable	MCAWW 160.2	5 mg/L	USOR Property-specific adjustment of freshwater ecological benchmark for silver

¹ Chemical Abstracts Service Registry Number² SW: EPA 1986; SM: APHA 1992; MCAWW: EPA; ASTM – American Society of Testing and Materials³ – Walkley and Black, 1934.

Table 14 - Quality Control Performance Criteria for COPC Analyses

QC Sample Type	Requirement
Equipment Blank	Daily per matrix and decontaminated equipment type < MQL
Field Duplicate	1 every 10 samples ≤30 RPD or ± 2x MQL (aqueous) ≤50 RPD or 3x MQL (solid)
Trip Blank	One per sample cooler (VOCs only) <MQL
Preparation (Laboratory) Blank	Daily per method digestion/extraction/analysis batch (maximum 20 samples) per matrix < ± MQL
Initial Calibration and Continuing Calibration Blank	Analyze immediately after each initial calibration verification and continuing calibration verification (Metals only) < ± MQL
Laboratory Control Sample	Daily per digestion batch per matrix (duplicate LCS required for TPH) %Recovery See Table 16
Surrogate	Every sample (excluding Metals) % Recovery See Table 16
Matrix Spike	One per 20 samples per matrix %Recovery See Table 16
Matrix Spike Duplicate	One per 20 samples per matrix % Recovery Relative Percent Difference See Table 16
Internal Standard	Each sample 70-120% recovery (Metals by 6020) Each sample 50-100% of amount in calibration standard; Retention time within ±30 seconds from last calibration (VOCs and SVOCs)
Interference Check Sample	One per analytical run (ICP Metals only) 80-120% recovery
Confirmatory Analysis	Second GC column or GC/MS (Herbicides and Pesticides)
Method Detection Limit Verification	Quarterly during sample analyses No control limits

Table 15 Data Qualification Criteria

Method	Calibration Max %RSD	Calibration Min r	Calibration Min RRF	ICV/CCV %R	Internal Standard Area
6010D/6020B	NA	0.998	NA	90-110% ⁽¹⁾	70 – 120%
7470A/7471A	NA	0.995	NA	80-120%	NA
8081B	20%	0.99	NA	+/-20%	NA
8151A	20%	0.99	NA	+/-20%	NA
8260B	20%	0.99	0.05	+/-20%	-50% to +100%
8270D	20%	0.99	0.05	+/-20%	-50% to +100%
TX1005/TX1006	25%	0.995	NA	+/-25%	NA

Notes:

1) 70-130% for low-level ICV/CCV.

Table 16 - LCS, MS/MSD and Surrogate Precision and Accuracy for COPC Analyses ^a

Analyte	LCS	MS/MSD ^b				Surrogate ^c	
		Aqueous		Solid		Aqueous	Solid
	%R	%R	RPD	%R	RPD	%R	%R
Herbicides							
2,4-Dichlorophenylacetic acid	NA	NA	NA	NA	NA	60 - 140	60 - 140
Herbicides listed in Tables 3 and 8	60 - 140	60 - 140	30	60 - 140	40	NA	NA
Pesticides							
Decachlorobiphenyl	NA	NA	NA	NA	NA	60 - 140	60 - 140
Tetrachloro-m-xylene	NA	NA	NA	NA	NA	60 - 140	60 - 140
Pesticides listed in Tables 3 and 8	60 - 140	60 - 140	30	60 - 140	40	NA	NA
Total Petroleum Hydrocarbons (TPH)							
2-Fluorobiphenyl	NA	NA	NA	NA	NA	70 – 130	70 - 130
Trifluoromethyl benzene	NA	NA	NA	NA	NA	70 – 130	70 - 130
TPH Fractions listed in Tables 6 and 11	60 - 140	60 - 140	30	60 - 140	40	NA	NA
Semivolatile Organic Compounds (SVOCs)							
Nitrobenzene-d ₅	NA	NA	NA	NA	NA	60 - 140	60 – 140
2-Fluorobiphenyl	NA	NA	NA	NA	NA	60 - 140	60 – 140
Terphenyl-d ₁₄	NA	NA	NA	NA	NA	60 - 140	60 – 140
Phenol-d ₅	NA	NA	NA	NA	NA	60 - 140	60 – 140
2-Fluorophenol	NA	NA	NA	NA	NA	60 - 140	60 – 140
2,4,6-Tribomophenol	NA	NA	NA	NA	NA	60 - 140	60 – 140
SVOCs listed in Tables 4 and 9	60 - 140	60 - 140	30	60 - 140	40	NA	NA
Volatile Organic Compounds (VOCs)							
1,2-Dichloroethane-d ₄	NA	NA	NA	NA	NA	60 - 140	60 – 140
Dibromofluoromethane	NA	NA	NA	NA	NA	60 - 140	60 – 140
Toluene-d ₈	NA	NA	NA	NA	NA	60 - 140	60 – 140
Bromofluorobenzene	NA	NA	NA	NA	NA	60 - 140	60 – 140
VOCs listed in Tables 5 and 10	60 - 140	60 - 140	30	60 - 140	40	NA	NA
Metals							
Metals (including mercury) listed in Tables 2 and 7	80-120	70-130 ^d	30	70-130 ^d	30	NA	NA

Table 16 - LCS, MS/MSD and Surrogate Precision and Accuracy for COPC Analyses ^a

Analyte	LCS	MS/MSD ^b				Surrogate ^c	
		Aqueous		Solid		Aqueous	Solid
	%R	%R	RPD	%R	RPD	%R	%R
^a Precision and accuracy limits for contractor data review and data validation. Laboratories will review data based on statistically determined control limits. ^b If the matrix spike amount is less than four times the unspiked parent sample amount, the MS/MSD data may not represent the matrix effect and professional judgment should be used to evaluate and qualify the data. ^c Alternate surrogate standards are acceptable if standards do not interfere with identification and quantification of target analytes and method recovery criteria are met. ^d If the spike recovery is outside the control limit and the unspiked sample result is less than four times the spike concentration, a post-digestion or post-distillation spike analysis must be performed. Post-digestion or post-distillation spike: spike a portion of a prepared sample, or its dilution at a minimum level of 10 times the MDLs and the spike recovery should be within 80% to 120% of the known value. NA – Not Applicable							

Table 17 – Quality Control Performance Criteria for Fate and Transport Analyses

Quality Control Parameter	Chloride	Hardness	pH (Soil)	Salinity	Total Dissolved Solids	Total Organic Carbon	Total Suspended Solids
Method	SW 9056A	SW 6010D/6020B	SW 9045C	SM 2520B	EPA 160.1	Walkley-Black	EPA 160.2
Equipment Blank	NA	NA	NA	NA	NA	NA	NA
Field Duplicate	NA	NA	NA	NA	NA	NA	NA
Negative Control	Laboratory blank < MQL	Laboratory blank < MQL	NA	NA	NA	Laboratory blank < MQL	NA
Matrix Spike / Matrix Spike Duplicate	One per 20 samples per matrix 80 – 120 %Recovery < 15 RPD	One per 20 samples per matrix 70 – 130 %Recovery < 30 RPD	NA	NA	NA	NA	NA
Positive Control	Laboratory control sample 80 – 120 %Recovery	Laboratory control sample 80 – 120 %Recovery	pH 7.0 buffer ± 0.1 pH unit	NA	NA	Laboratory control sample 80 – 120 %Recovery	NA

Table 18 - Containers, Preservatives, and Holding Times – Aqueous Samples

Parameter	Minimum Volume	Preferred Volume	Container ¹	Preservative	Holding Time ²
Chloride	250 mL	500 mL	One 16-oz HDPE bottle with Teflon®-lined cap	None	28 days from sample collection ^a
Metals (Dissolved)	200 mL	500 mL	One 16-oz HDPE bottle with Teflon®-lined cap	Cool to ≤ 6°C	Filter in laboratory with 0.45 µm filter within 24 hours of receipt; Laboratory preserved with HNO ₃ to pH < 2; Mercury - 28 days from sample collection; 6 months for other metals
Metals (Total) / Hardness	200 mL	500 mL	One 16-oz HDPE bottle with Teflon®-lined cap	Cool to ≤ 6°C; HNO ₃ to pH < 2	Mercury - 28 days from sample collection; 6 months for other metals
Herbicides	500 mL	2000 mL	Two 32-oz glass bottles with Teflon®-lined cap	Cool to ≤ 6°C	Extract within 7 days of sample collection; analyze extracts within 40 days of extraction
Pesticides	500 mL	2000 mL	Two 32-oz n glass bottles with Teflon®-lined cap	Cool to ≤ 6°C ^{oo}	Extract within 7 days of sample collection; analyze extracts within 40 days of extraction
Total Petroleum Hydrocarbons (TPH)	40 mL (i.e., one full VOA vial)	120 mL	Three 40-mL VOA vials with Teflon®-lined cap	Cool to < 6°C; HCl to pH <2. Fill container completely. Store extracts at < -12°C	Extract within 14 days of sample collection; analyze extracts within 14 days of extraction
Low-Level Semivolatiles	1000 mL	2000 mL	Two 32-oz amber glass bottles with Teflon®-lined cap	Cool to ≤ 6°C	Extract within 7 days of sample collection; analyze extracts within 40 days of extraction
Salinity	100 mL	100 mL	One 8-oz HDPE bottle with Teflon®-lined cap	Cool to ≤ 6°C	28 days from sample collection
Semivolatiles	500 mL	2000 mL	Two 32-oz glass bottles with Teflon®-lined cap	Cool to ≤ 6°C	Extract within 7 days of sample collection; analyze extracts within 40 days of extraction
Total Dissolved Solids / Total Suspended Solids	200 mL	200 mL	One 8-oz HDPE bottle with Teflon®-lined cap	Cool to ≤ 6°C	7 days from sample collection
Volatiles	40 mL (i.e., one full VOA vial)	120 mL	Three 40-mL VOA vials with Teflon®-lined cap	Cool to ≤ 6°C; HCl to pH <2. Fill container completely	14 days from sample collection
¹ Triple the sample volume will be required for samples designated as matrix spike/matrix spike duplicates. ² SW-846 Chapter 3 (Inorganic Analytes) and Chapter 4 (Organic Analytes), Revision 4, February 2007 ^a 72 FR 47 11200 (March 12, 2007)					

Table 19 - Containers, Preservatives and Holding Times – Solid Samples

Parameter	Minimum Volume	Preferred Volume	Container ¹	Preservative	Holding Time ²
pH	20 grams	20 grams	Utilize metals sample jar	None	Analyze as soon as possible
Metals	5 grams	25 grams	One 4-oz wide-mouth glass jar with Teflon®-lined cap	Cool to ≤ 6°C	Mercury: 28 days from sample collection; 6 months for other metals
Herbicides	50 grams	200 grams	Utilize SVOCs jar	Cool to ≤ 6°C	Extract within 14 days of sample collection; analyze extracts within 40 days of extraction.
Pesticides	50 grams	200 grams	Utilize SVOCs jar	Cool to ≤ 6°C	Extract within 14 days of sample collection; analyze extracts within 40 days of extraction.
Total Petroleum Hydrocarbons (TPH)	3 x 10 grams	30grams	Terracore© Sample Kit containing 1 2-oz soil jar and 3 40-ml unpreserved VOA vials	In field, cool to ≤ 6°C; In laboratory freeze samples and extracts to < -12°C	Extract within 14 days of sample collection; analyze extracts within 14 days of extraction.
Semivolatiles and Low-Level Semivolatiles	50 grams	200 grams	One 8-oz wide-mouth glass jar with Teflon®-lined cap	Cool to ≤ 6°C	Extract within 14 days of sample collection; analyze extracts within 40 days of extraction.
Total Organic Carbon	2 grams	2 grams	One 4-oz wide-mouth glass jar with Teflon®-lined cap	Cool to ≤ 6°C	Analyze within 28 days of sample collection.
Volatiles (Sediments)	25 grams	25 grams	One 2-oz wide-mouth glass jar with Teflon®-lined cap; fill completely	Cool to ≤ 6°C	Analyze within 14 days of sample collection.
Volatiles (Soils)	3 x 5 grams	15 grams	Terracore© Sample Kit containing 1 2-oz soil jar, 1 40-ml VOA vial preserved with methanol, and 2 40-ml unpreserved VOA vials	Cool to ≤ 6°C	Freeze samples within 48 hours of sample collection; analyze within 14 days of sample collection.
¹ If sample jars filled, sufficient sample mass (triple required volume) will be available so that for each batch of 20 or fewer field samples, a matrix spike/matrix spike duplicate pair can be prepared. ² SW-846 Chapter 3 (Inorganic Analytes) and Chapter 4 (Organic Analytes), Revision 4, February 2007 ^a EPA, 1991					

Table 20 - Laboratory Electronic Data Deliverable Format

Column Headings	Data Type	Required	Comment
sys_sample_code	Text(40)	Y	Unique sample identifier. Required as written on the COC.
sample_delivery_group	Text(20)		The sampling event with which the sample is associated.
sample_date	DateTime	Y	Date and time sample was collected (in MM/DD/YYYY HH:MM:SS format).
sample_type_code	Text(20)	Y	Type of sample. Valid values include 'DUP', 'LB', 'LCS', 'LCSD', 'MB', 'MS', 'MSD', 'N', 'TB'.
lab_receipt_date	DateTime	Y	Date and time of sample receipt in MM/DD/YYYY HH:MM:SS format.
lab_anl_method_name	Text(20)	Y	Laboratory analytical method name or description.
analysis_date	DateTime	Y	Date and time of sample analysis in MM/DD/YYYY HH:MM:SS format.
Total_or_dissolved	Text(10)	Y	Must be either 'D' for dissolved or filtered [metal] concentration, 'T' for total or undissolved, or 'N' for anything else.
test_type	Text(10)	Y	Type of test. Valid values include 'INITIAL', 'REEXTRACT1', 'REEXTRACT2', 'REEXTRACT3', 'REANALYSIS', 'DILUTION1', 'DILUTIONS2', and 'DILUTIONS3'.
lab_matrix_code	Text(10)	Y	Code which distinguishes between different type of sample matrix. For example, soil samples must be distinguished from groundwater samples, etc. The matrix of the sample as analyzed may be different from the matrix of the sample as retrieved (e.g. leachates), so this field is available at both the sample and test level.
analysis_location	Text(2)		Must be either 'FI' for field instrument or probe, 'FL' for mobile field laboratory analysis, or 'LB' for fixed_based laboratory analysis.
basis	Text(10)	Y	Must be either 'Wet' for wet_weight basis reporting, 'Dry' for dry_weight basis reporting, or 'NA' for tests for which this distinction is not applicable. Results are reported on the basis of dry weight where applicable.
dilution_factor	Numeric	Y	Effective test dilution factor.
prep_factor	Numeric	Y	Effective test preparation factor.
Prep_method	Text(20)		Laboratory sample preparation method name or description.
Prep_date	DateTime	Y	Beginning date and time of sample preparation in MM/DD/YYYY HH:MM:SS format.
leachate_method	Text(15)		Laboratory leachate generation method name or description.
leachate_date	DateTime		Beginning date and time of leachate preparation in MM/DD/YYYY HH:MM:SS format.
lab_name_code	Text(20)		Unique identifier of the laboratory.
lab_sample_id	Text(20)	Y	Laboratory LIMS sample identifier. If necessary, a field sample may have more than one LIMS lab_sample_id (maximum one per each test event).
percent_moisture	Text(5)	Y	Percent moisture of the sample portion used in this test; this value may vary from test to test for any sample. Numeric format is 'NN.MM', i.e., 70.1% could be reported as '70.1' but not as '70.1%'.
subsample_amount	Text(14)		Amount of sample used for test.
subsample_amount_unit	Text(15)		Unit of measurement for subsample amount.
comment	Text(255)		Comments about the test.
preservative	Text(20)		Sample preservative used.

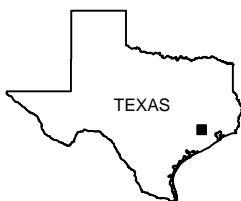
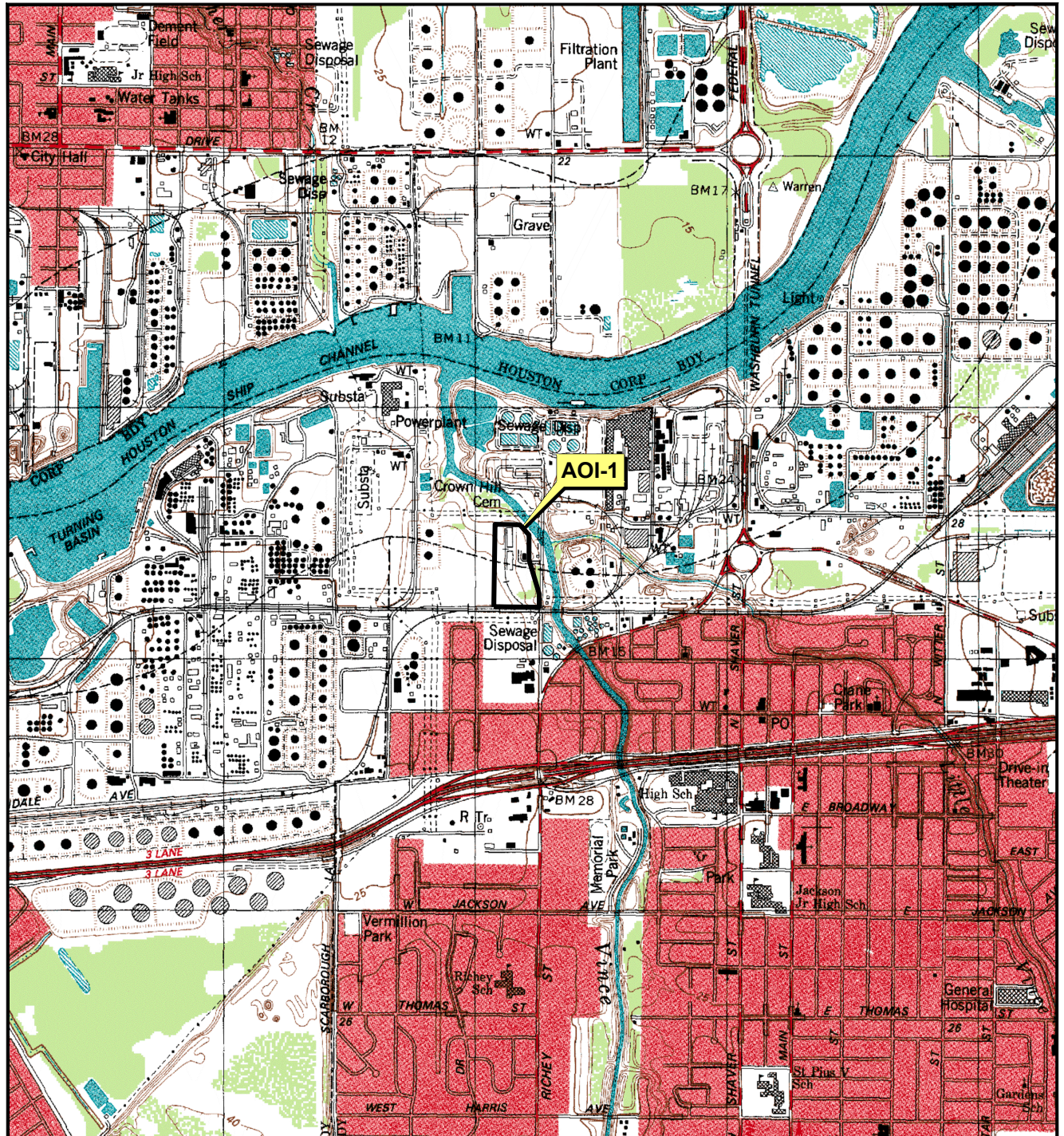
Table 20 - Laboratory Electronic Data Deliverable Format

Column Headings	Data Type	Required	Comment
Final_volume	Numeric		The final volume of the sample after sample preparation. Include all dilution factors.
Final_volume_unit	Text(15)		The unit of measure that corresponds to the final_amount.
cas_rn	Text(15)	Y	Use values in analyte valid value table.
chemical_name	Text(255)	Y	Use the name in the analyte valid value table.
result_value	Numeric	Y	Analytical result reported at an appropriate number of significant digits. May be blank for non-detects.
result_type_code	Text(10)	Y	Must be either 'TRG' for a target or regular result, 'TIC' for tentatively identified compounds, 'SUR' for surrogates, 'IS' for internal standards, or 'SC' for spiked compounds.
reportable_result	Text(10)	Y	Must be either 'Yes' for results which are considered to be reportable, or 'No' for other results. This field has many purposes. For example, it can be used to distinguish between multiple results where a sample is retested after dilution. It can also be used to indicate which of the first or second column result should be considered primary. The proper value of this field in both of these two examples should be provided by the laboratory (only one result should be flagged as reportable).
detect_flag	Text(2)	Y	May be either 'Y' for detected analytes or 'N' for non_detects. Use 'Y' for estimated values (above method detection limit but below the method quantitation limit).
lab_qualifiers	Text(20)	Y	Qualifier flags assigned by the laboratory.
method_detection_limit	Text(20)		Method detection limit.
reporting_detection_limit	Numeric	Y	Concentration level above which results can be quantified. It must reflect conditions such as dilution factors and moisture content. Required for all results for which such a limit is appropriate. The reporting_detection_limit column must be reported as the sample detection limit.
quantitation_limit	Text(20)		Method quantitation limit.
reporting_quantitation_limit	Numeric	Y	Concentration level above which results can be quantified with confidence (sample quantitation limit).
result_unit	Text(15)	Y	Units of measurement for the result.
detection_limit_unit	Text(15)	Y	Units of measurement for the detection limit(s). This field is required if a reporting_detection_limit is reported.
result_comment	Text(2000)		Result specific comments.
instrument_id	Text(15)		ID or name of instrument used in the laboratory during analysis.
analyst_name	Text(30)		Laboratory technician name or initials conducting the analysis.
test_batch	Text(20)	Y	Unique preparation/analysis batch identifier.
qc_original_conc	Numeric		The concentration of the analyte in the original (unspiked) sample. Might be required for spikes and spike duplicates (depending on user needs). Not necessary for surrogate compounds or LCS samples (where the original concentration is assumed to be zero).
qc_spike_added	Numeric		The concentration of the analyte added to the original sample. Might be required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample.

Table 20 - Laboratory Electronic Data Deliverable Format

Column Headings	Data Type	Required	Comment
qc_spike_measured	Numeric		The measured concentration of the analyte. Use zero for spiked compounds that were not detected in the sample. Might be required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample.
qc_spike_recovery	Numeric	Y	The percent recovery calculated as specified by the laboratory QC program. Always required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage multiplied by 100 (e.g., report "120%" as "120").
qc_dup_original_conc	Numeric		The concentration of the analyte in the original (unspiked) sample. Might be required for spike or LCS duplicates only (depending on user needs). Not necessary for surrogate compounds or LCS samples (where the original concentration is assumed to be zero).
qc_dup_spike_added	Numeric		The concentration of the analyte added to the original sample. Might be required for spike or LCS duplicates, surrogate compounds, and any spiked and duplicated sample (depending on user needs). Use zero for spiked compounds that were not detected in the sample. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Also complete the qc_spike_added field.
qc_dup_spike_measured	Numeric		The measured concentration of the analyte in the duplicate. Use zero for spiked compounds that were not detected in the sample. Might be required for spike and LCS duplicates, surrogate compounds, and any other spiked and duplicated sample (depending on user needs). Also complete the qc_spike_measured field.
qc_dup_spike_recovery	Numeric	Y	The duplicate percent recovery calculated as specified by the laboratory QC program. Always required for spike or LCS duplicates, surrogate compounds, and any other spiked and duplicated sample. Also complete the qc_spike_recovery field. Report as percentage multiplied by 100 (e.g., report "120%" as "120").
qc_rpd	Text(8)	Y	The relative percent difference calculated as specified by the laboratory QC program. Required for duplicate samples as appropriate. Report as percentage multiplied by 100 (e.g., report "30%" as "30").
qc_spike_lcl	Text(8)		Lower control limit for spike recovery. For spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage multiplied by 100 (e.g., report "60%" as "60").
qc_spike_ucl	Text(8)		Upper control limit for spike recovery. For spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage multiplied by 100 (e.g., report "60%" as "60").
qc_rpd_cl	Text(8)		Relative percent difference control limit. For any duplicated sample. Report as percentage multiplied by 100 (e.g., report "25%" as "25").
<p>Y indicates items required in the laboratory electronic data deliverable.</p> <p>Electronic data deliverables from the laboratory must be submitted in a comma separated variable (CSV) file or an Excel (xls) file using the standard format.</p>			

FIGURES



QUADRANGLE LOCATIONS



Scale in Feet
0 1000 2000

SOURCE:
Base map from www.tnris.gov, Pasadena, TX 7.5 min. USGS quadrangle dated 1982.

US OIL RECOVERY SUPERFUND SITE PASADENA, HARRIS COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 3333-3-QAPP	BY: AJD	REVISIONS
DATE: DEC., 2015	CHECKED: MKW	

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EXPLANATION

- Approx. Property Boundary
- 100 Yr Flood Plain - Zone AE (1% Annual Chance Flood Event)
- Floodway Areas in Zone AE
- Other Flood Areas - Zone X (0.2% Annual Chance Flood)
- Background Surface Water & Sediment Sample Area

Note:
Source of Flood Plain Area, <http://www.fema.gov>,
FIRM map # 48201C0905L, Harris County, 2007.



Approx. Scale in Feet
0 275 550

Source:
Houston-Galveston Area Council, April 2012 Image, 2012 Aerial Imagery Data is the sole property of Houston-Galveston Area Council, which reserves all rights thereto. Use or reproduction of this data is strictly prohibited absent written consent from the Houston-Galveston Area Council.

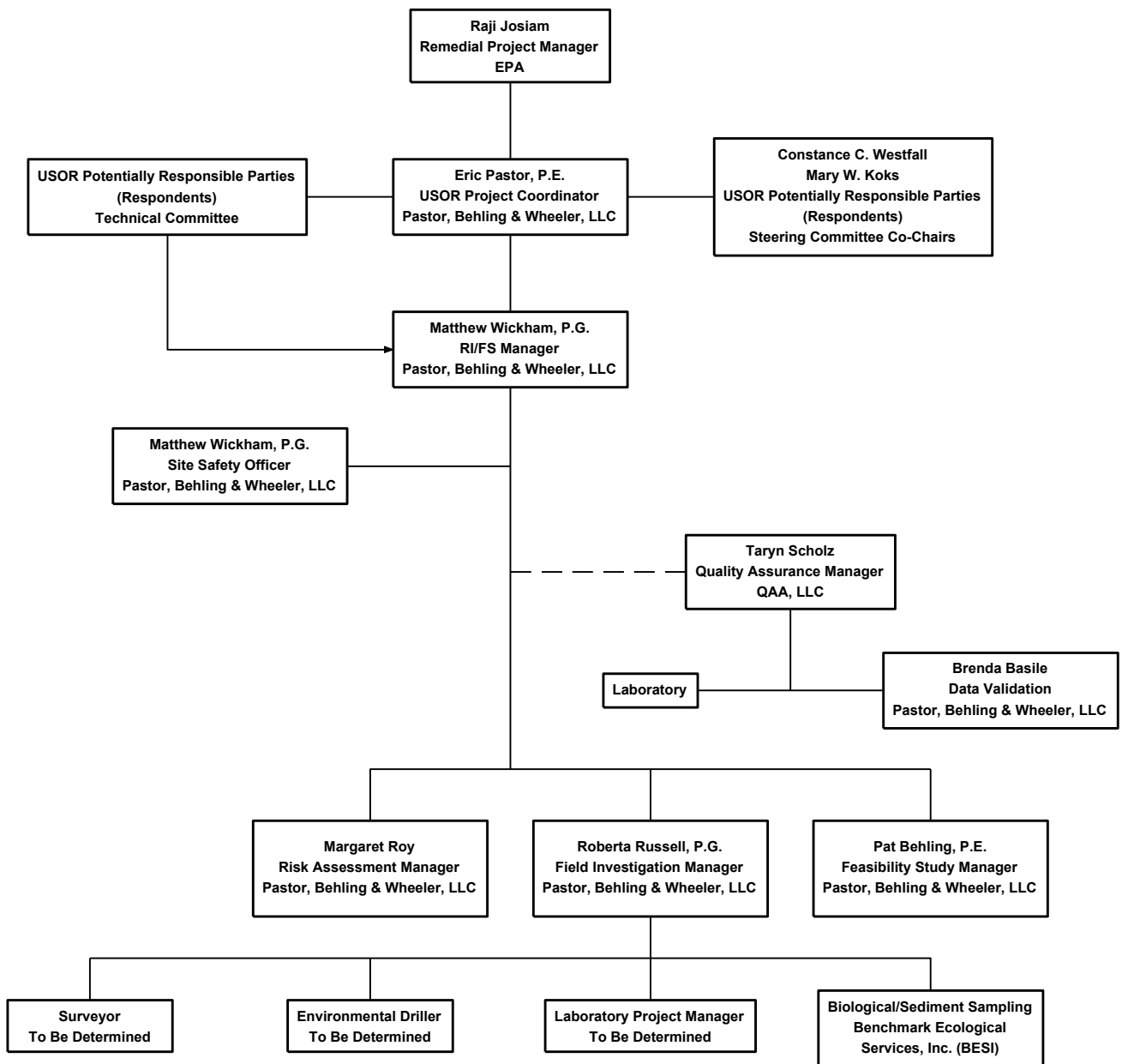
**US OIL RECOVERY SUPERFUND SITE
PASADENA, HARRIS COUNTY, TEXAS**

Figure 2

SITE VICINITY MAP

PROJECT: 3333-3 QAPP	BY: AJD	REVISIONS
DATE: DEC., 2015	CHECKED: MKW	

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LEGEND:

- Formal Project Communications Line
- - - Informal Project Communications Line (as needed)

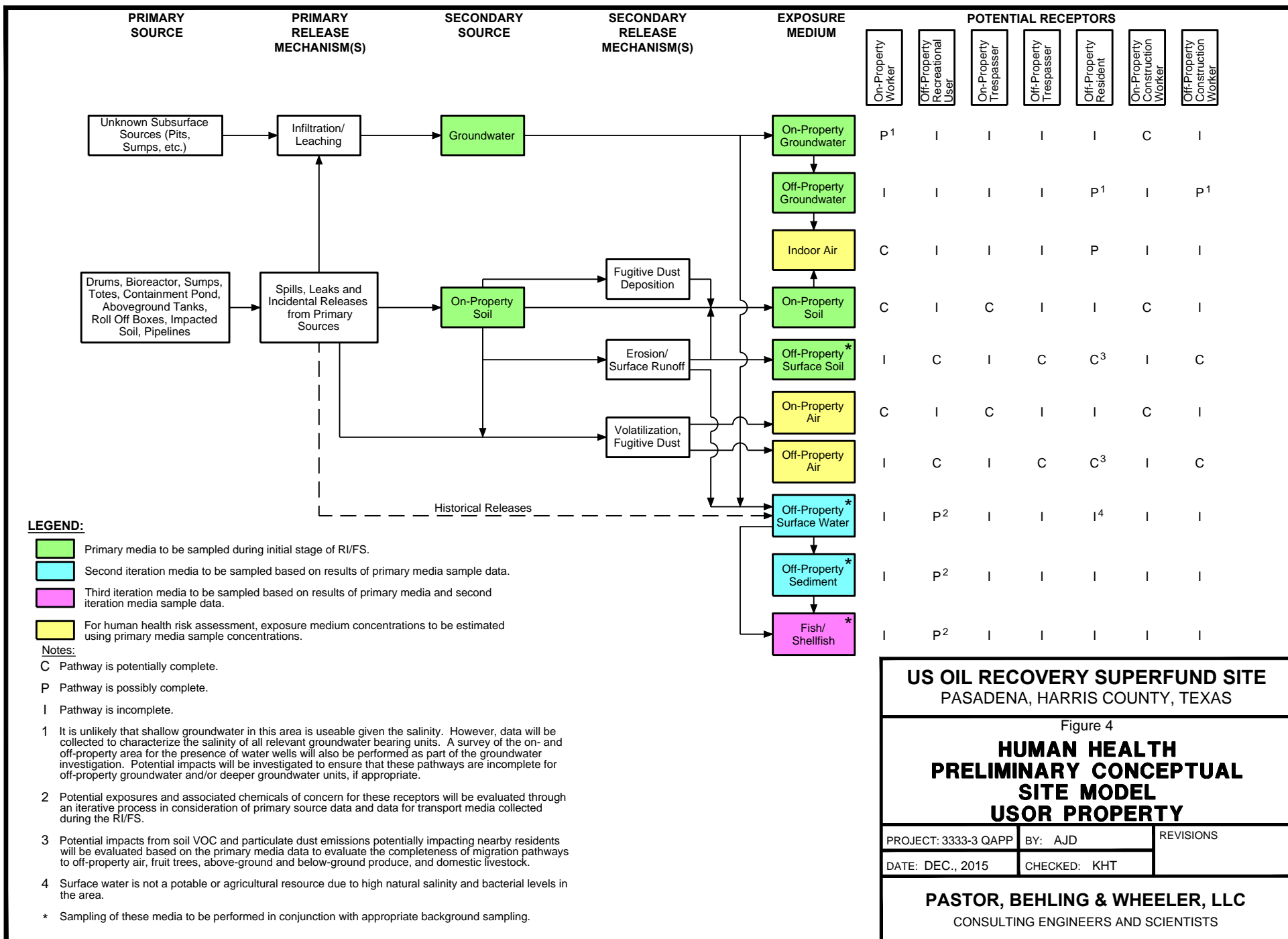
US OIL RECOVERY SUPERFUND SITE
PASADENA, HARRIS COUNTY, TEXAS

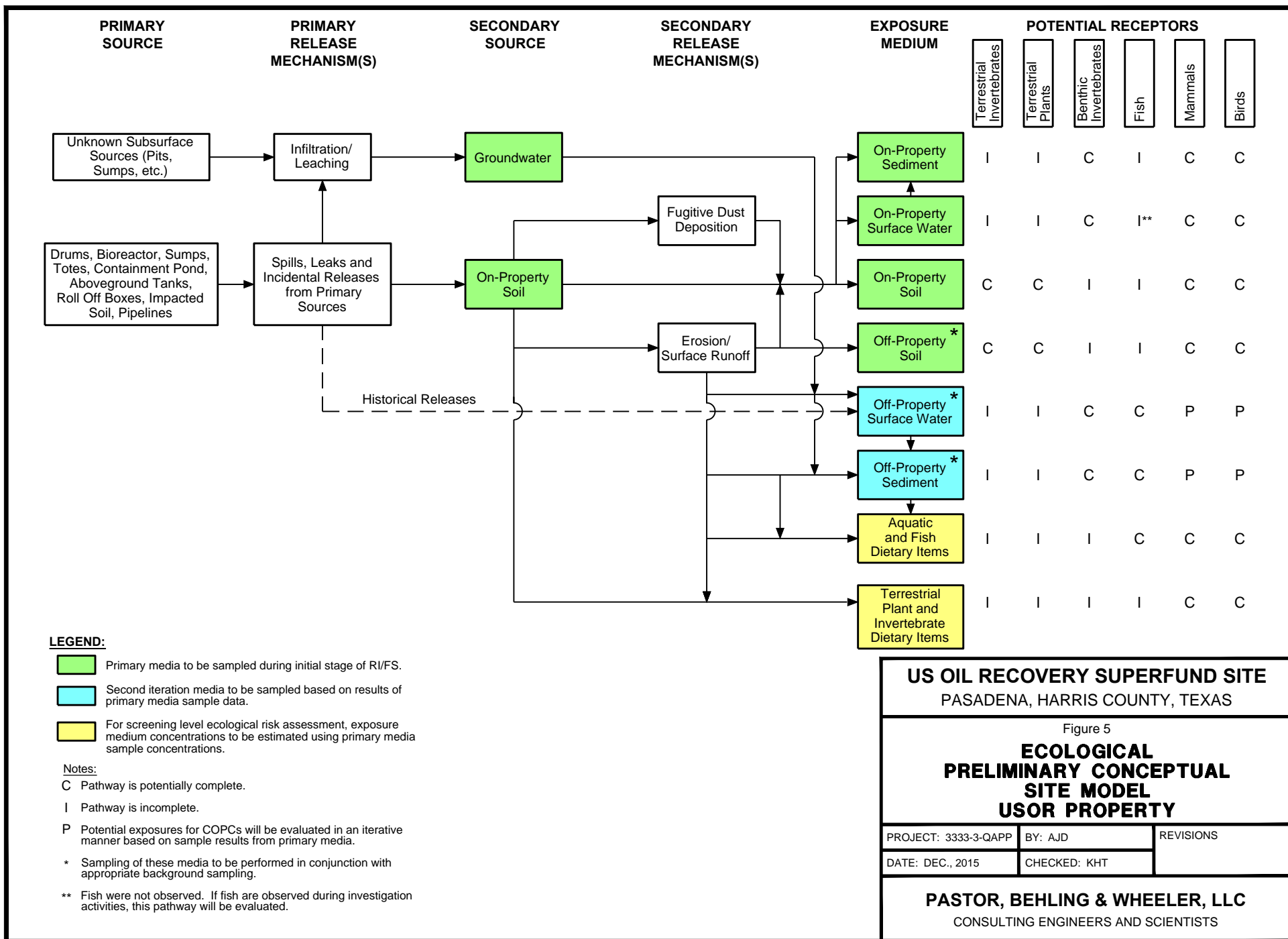
Figure 3

PROJECT ORGANIZATION

PROJECT: 3333-3-QAPP	BY: AJD	REVISIONS
DATE: DEC., 2015	CHECKED: MKW	

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APPENDICES

APPENDIX A

DATA VERIFICATION AND VALIDATION STANDARD OPERATING PROCEDURE

Pastor, Behling & Wheeler, LLC

**STANDARD OPERATING PROCEDURE No. 16
FOR DATA VERIFICATION AND VALIDATION**

SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes a protocol for the verification and validation of analytical laboratory data collected for various state and federal environmental programs, including Superfund, Corrective Action, Voluntary Cleanup, Leaking Petroleum Storage Tanks, and Dry Cleaners. Included in this protocol are procedures to verify and validate the accuracy, precision, and completeness with respect to project-specific method quality objectives (MQOs). The MQO hierarchy for verification and validation of analytical laboratory data are:

- 1) Project specific Quality Assurance Project Plan (QAPP)
- 2) State regulatory guidance such as RG-366/TRRP-13 (Review and Reporting of COC Concentrations Data under TRRP)
- 3) Method specific criteria

The QAPP and applicable SOPs must be reviewed before this SOP is used to assess laboratory data. The individual performing data verification and validation shall be familiar with the analytical method and other procedures used for the project. Familiarity with project and laboratory quality control requirements is critical to appropriate use of this procedure.

The individual performing data verification and validation must also be familiar with the USEPA National Functional Guidelines (NFG). The SOP provides guidance for application of the data qualifiers; however, analytical circumstances surrounding sample analyses are variable and the reviewer may need to refer to the NFG for further information.

Associated SOPs

The following SOPs contain specific methodologies or procedures which influence the quality of data and should be considered as part of the data verification and validation process:

PBW SOP No. 1 Field Documentation

PBW SOP No. 5 Soil and Sediment Sampling for Chemical Analysis

PBW SOP No. 6 Sample Custody, Packaging and Shipment

PBW SOP No. 10 Water Quality Sampling

ACRONYMS

%R – Percent Recovery	LRC – Laboratory Review Checklist
CCB – Continuing Calibration Blank	MDL – Method Detection Limit
CCV – Continuing Calibration Verification	MQL – Method Quantitation Limit
C-O-C – Chain-of-custody	MS/MSD – Matrix Spike/Matrix Spike Duplicate
DCS – Detectability Check Sample	PDS – Post-digestate Spike
EPA – Environmental Protection Agency	r – Correlation coefficient
ER – Exception Report	RPD – Relative Percent Difference
GC/MS – Gas Chromatography/Mass Spectrometry	RRF – Relative Response Factor
ICB – Initial Calibration Blank	RSD – Relative Standard Deviation
ICAL – Initial Calibrations	SDL – Sample Detection Limit
ICP – Inductively Coupled Plasma	SOP – Standard Operating Procedure
ICP/MS – ICP/Mass Spectrometry	SQL – Sample Quantitation Limit
ICS – Interference Check Sample	SVOC – Semivolatile Organic Compound
ICV – Initial Calibration Verification	VOA – Volatile Organic Analysis
LCS/LCSD – Laboratory Control Sample/Laboratory Control Sample Duplicate	VOC – Volatile Organic Compound

DEFINITIONS

Definitions of accuracy, precision and completeness and methods for computing their measures are provided below.

Accuracy

Accuracy is the degree of agreement between an observed value (or an average of several values) and an accepted reference value. Data accuracy and analytical bias are often assessed by the analysis of LCS, MS samples, and/or surrogate spikes with results expressed as a percentage recovery measured relative to the reference (known) concentration.

The percentage recovery for LCS or surrogate spikes is calculated as:

$$\% \text{ Recovery} = \frac{\text{measured amount}}{\text{known amount}} \times 100$$

The percentage recovery for MS samples is calculated as:

$$\% \text{ Recovery} = \frac{\text{spiked sample result} - \text{sample result}}{\text{theoretical spike concentration}} \times 100$$

Method blanks and equipment blanks are analyzed to quantify artifacts introduced during sampling, transport, or analysis that may affect the accuracy of the data.

Precision

Precision is a measure of the reproducibility between two or more measurements of the same characteristic (i.e., analyte, parameter) under the same or similar conditions. Field precision is assessed by determining the agreement for results for two independent samples collected from the same site at the same time. Laboratory precision is assessed by determining the agreement of results for replicate measurements of the same sample. Precision may be evaluated using LCS/LCSD samples, MS/MSD samples, laboratory duplicate samples and/or field duplicate samples.

The RPD used to assess precision is calculated as:

$$\text{RPD} = \frac{\text{ABS (primary sample result} - \text{duplicate sample result)}}{\text{average of primary and duplicate sample result}} \times 100$$

Completeness

Completeness is expressed as the percentage of valid data points obtained from a measurement system or method. Analytical completeness is affected by such factors as sample bottle breakage and acceptance/non-acceptance of analytical results. Percentage completeness (C) is calculated as:

$$C (\%) = \frac{V}{P} \times 100$$

where: V = number of valid (usable) measurements obtained (all data other than rejected data; and
P = number of measurements planned.

Definitions for the different types of reporting limits are provided below.

Method Detection Limit (MDL)

The minimum concentration of an analyte that the laboratory can measure and report with 99% confidence that the analyte concentration is greater than zero. The MDL is determined by the laboratory for each analyte in a given reagent matrix (water or soil) generally using the procedures specified in 40 CFR Part 136, Appendix B. It is a measure of the concentration an instrument can detect or 'see' in a given reagent matrix. Project quality objectives include a requirement that the laboratory routinely check the MDL for reasonableness and update them as necessary.

Sample Detection Limit (SDL)

The MDL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and taking into account sample characteristics, sample preparation, and analytical adjustments including dry-weight adjustments. It is a measure of the concentration an instrument can detect or 'see' in a given sample. Non-detects are reported using the SDL for projects in Texas. Reporting conventions for other regulatory programs should be verified with the appropriate regulatory agency.

Method Quantitation Limit (MQL)

The lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. For single point calibrations, such as metals, the MQL is set based on project requirements with a low-level check standard at or below the MQL. The MQL is a measure of the concentration an instrument can accurately measure in a typical sample.

Sample Quantitation Limit (SQL)

The MQL adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and taking into account sample characteristics, sample preparation, and analytical adjustments including dry-weight adjustments. It is a measure of the concentration an instrument can accurately measure in a given sample. Analytes with concentrations above the SDL but below the SQL, though present in the sample, may not be accurately measured and are thus flagged as estimated (J).

Data Qualifiers

As a result of data verification or validation, data qualifiers may be applied to individual analytical results. Definitions of the qualifiers are as follows:

<u>Qualifier</u>	<u>Definition</u>
J	Analyte confirmed present, but the reported value is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
JH	The reported value is an estimated quantity, and the result may be biased high.
JL	The reported value is an estimated quantity, and the result may be biased low.
R	The data are not usable due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.
U	Analyte was not detected above 5x (10x for common contaminants) the level in an associated blank.
UJ	Analyte not detected at or above the sample detection limit, but the reported limit is an estimated quantity. The associated numerical value is an approximate concentration that may be inaccurate or imprecise.
NJ	Analyte tentatively identified. Presence of the analyte is not confirmed and the reported value is an estimated quantity.

Note: The J data qualifier may be assigned to laboratory data that was flagged by the laboratory as an estimated concentration between the laboratory SDL and the SQL.

When an option exists to assign two different flags, the flag higher in the data quality hierarchy will be assigned. The hierarchy is:

$$R > UJ > U > NJ > J > JH \text{ or } JL$$

Additional explanation regarding assignment of qualifiers, in accordance with the review procedures detailed below, is provided in Table 1.

PROCEDURES

Data Verification

A Data Verification Checklist is attached to this SOP. The checklist will be completed to document the Data Verification process. The first part of the Data Verification Checklist will be completed according to the following procedure:

- 1) Review QAPP tables and note the analytical methods, QC samples and associated control limits specified for each analyte/media.
- 2) Review the C-O-C. Verify that necessary information was provided on each C-O-C and that required signatures are present. Verify that analytical laboratory results were reported for all samples listed on the C-O-Cs. Verify that custody seals were used unless samples were hand-delivered. Note any problems documented on the C-O-Cs by either the sampler or the laboratory.
- 3) Verify that field quality control samples were submitted at the project-specified frequency.
- 4) Review laboratory records of sample temperature upon receipt and preservation information to verify that samples were properly preserved and VOA vials were completely filled. Document any field sample results requiring qualification based on inadequate sample preservation on the Qualified Data Table section of the Validation Checklist.
- 5) Verify the correct field identifications, analytical method references, sample matrix, and proper reporting units were included in the laboratory report. Verify that soil and sediment results are corrected for dry-weight.
- 6) Briefly summarize the LRCs and ERs, or note if not present. Summarize any notes or comments documented throughout the laboratory report.
- 7) Verify that each sample was prepared and analyzed within the recommended holding time. Document any field sample results requiring qualification on the Qualified Data Table section of the Verification Checklist.
- 8) Review the SDLs reported by the laboratory against the project MQOs. Note elevated SDLs that are above the project MQOs for non-detects and assess if the elevated limits are justified by analytical limitations or anomalies. Apply the J data qualifier to all results between the SDL and SQL, as indicated by laboratory J flag.
- 9) Verify that MDLs have been routinely checked for reasonableness using the DCS.
- 10) Review the initial calibration data to ensure proper instrument operating conditions for analysis and quantification of field sample results. Verify the appropriate number of standards was used and the %RSD or r meets the project MQOs. Apply data qualifiers to the associated field sample results according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifiers in the event the situation is not adequately defined in Table 1. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 11) For inorganics, verify the ICV was analyzed after the calibration curve and the CCV samples were analyzed after every ten samples and the recoveries meet the project MQOs. Apply data qualifiers to the associated field sample results (those analyzed after the ICV or near the CCV) according to the

guidelines in Table 1 of this SOP. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.

- 12) For organics, verify CCV samples were analyzed every twelve-hour analytical shift and the recoveries meet the project MQOs. Apply data qualifiers to the associated field sample results (those analyzed on the same shift) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 13) For inorganics, verify that the ICB was analyzed immediately after the ICV and the CCBs were analyzed immediately after the CCVs and the concentrations do not exceed the MQLs. Apply data qualifiers to the associated field sample results (those analyzed after the ICB or near the CCB) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 14) Verify that one method blank was analyzed per analytical batch (maximum 20 samples or per 12-hour shift for VOCs). Review the results of method, equipment, and trip blanks and verify that the concentrations do not exceed the reporting limit. If an analyte was detected in a method blank or equipment blank, check to see if any field sample analyte concentrations associated with that blank were less than five times (ten times for the common laboratory contaminants acetone, 2-butanone, methylene chloride, toluene, and phthalates) the blank concentration. If an associated sample result is less than five (or ten) times the blank concentration, the result is potentially biased high and will be qualified. If an analyte is detected in the method blank and also in an equipment blank, first apply the five times rule using the method blank concentration. The equipment blank results may be considered non-detect due to method blank contamination. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical batch or collected at the same time) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 15) Verify that one LCS was analyzed per analytical batch (maximum 20 samples) and recoveries are in compliance with project MQOs. For analytical batches with an LCS and LCSD, compare the mean recovery to the control limits. Single recoveries below 40% for inorganics or 20% for organics may indicate serious instrument or calibration problems. Professional judgment should be used to evaluate whether sample results associated with low-biased LCS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical batch) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 16) Verify one MS was analyzed for every twenty field samples and recoveries are in compliance with project MQOs. For analytical batches with an MS and MSD, compare the mean recovery to the control limits. Professional judgment (and for metals, PDS results, if available) should be used to evaluate whether sample results associated with low-biased MS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the field sample results according to the guidelines in Table 1 of this SOP. Qualifiers are not applied if the amount of the spike is not at least four times the amount in the unspiked sample. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 17) Verify one laboratory duplicate, MSD, or LCSD was analyzed for every twenty field samples and the RPDs are in compliance with project MQOs. Qualifiers are not applied if one or both of the results are less than the MQL. If an RPD is outside of the control limits, the associated data should be considered estimated values due to poor analytical precision. Apply data qualifiers to the associated

field sample results (those analyzed in the same analytical batch and with similar sample matrix) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.

- 18) Calculate RPDs for field duplicates and verify they are in compliance with project MQOs. Qualifiers are not applied if one or both of the results are less than the MQL. Field duplicates measure both field and laboratory precision; therefore the results may have more variability than laboratory duplicates that only measure laboratory precision. If an RPD is outside of the control limits, the associated data should be considered estimated due to poor field and/or laboratory precision. The assessment of field precision will alert the data user to the possible heterogeneity of the sample matrix. Document any field sample results requiring qualification on the Qualified Data Table section of the Review Checklist.
- 19) Verify the appropriate surrogates were used for each organic analysis and recoveries are in compliance with project MQOs. Surrogate recoveries below 10% may indicate serious analytical problems. Professional judgment should be used to evaluate whether sample results associated with low-biased surrogate recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those for target analytes of the same type as the surrogate) according to the guidelines in Table 1 of this SOP. Qualifiers should not be applied if the surrogates were diluted out of the sample. Note these cases and use the LCS and MS to assess accuracy for the affected samples. Refer to the NFG for application of data qualifier flags in the event the situation is not adequately defined in Table 1. Document any field sample results requiring qualification based on surrogate recoveries outside control limits on the Qualified Data Table section of the Review Checklist.
- 20) Verify the appropriate internal standards were used for GC/MS and ICP/MS analyses and responses meet the data qualification criteria. Low internal standard areas may indicate serious analytical problems. Professional judgment should be used to evaluate whether sample results associated with low internal standard areas should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those for target analytes quantitated with the internal standard) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not adequately defined in Table 1. Document any field sample results requiring qualification based on internal standard areas not meeting requirements on the Qualified Data Table section of the Review Checklist.
- 21) Calculate the completeness as defined in Section 2.0 of this SOP. Report the calculated completeness percentage on the checklist.
- 22) Complete the Set Summary section of the Review Checklist. Report the number of field and QC samples and the total number of measurements on the summary. Summarize the types and number of qualifying flags and report the completeness percentages. Present a summary of data use and list any data that has elevated reporting limits or is rejected for use.

Data Validation

The Data Verification Checklist will be completed as above and the Data Validation Checklist will be completed according to the following procedures:

- 1) Verify that the sample results were calculated correctly and transcribed properly from the raw data by checking the values against the instrument printout (taking into account any preparation

or dilution factors noted in the laboratory preparation and/or run logs) for 10% of the samples. Check the sample results for reasonableness, i.e. chromatographic profile should be consistent with order of magnitude of results, total metals should not be less than dissolved metals, total metal should not be less than speciated metal, etc.)

- 2) Verify that the QC parameters (including ICAL %RSD (or r), RRF, ICV/CCV %R, LCS %R, MS/MSD %R, duplicate RPD, surrogate %R, internal standard relative area, and ICS %R) are calculated correctly by re-calculating the values using data on the instrument printout for one analyte in 10% of the samples.
- 3) For GC/MS, verify that the tuning performance solution was analyzed every twelve-hour analytical shift and the ion abundance criteria are within the analytical method requirements. Apply data qualifiers to the associated field sample results (those analyzed on the same shift) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification based on tuning performance criteria on the Qualified Data Table section of the Validation Checklist.
- 4) For GC/MS, verify that the RRF for the target analytes in each calibration standard meet the MQOs. Professional judgment should be used to evaluate whether sample results associated with low calibration RRFs should be rejected or if it may be possible to elevate the reporting limits to a concentration where an acceptable response was obtained. Apply data qualifiers to the associated field sample results (those quantitated with the calibration curve) according to the guidelines in Table 1 of this SOP. Document any field sample results requiring qualification on the Qualified Data Table section of the Validation Checklist.
- 5) For ICP metals, verify that the ICS was analyzed every analytical run and the recoveries are within the project MQOs. Professional judgment should be used to evaluate whether sample results associated with low-biased ICS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Apply data qualifiers to the associated field sample results (those analyzed in the same analytical run) according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification on the Qualified Data Table section of the Validation Checklist.
- 6) For ICP metals, verify that the ICB, CCB, and method blanks do not have negative concentrations whose absolute value exceeds the MQL. Apply data qualifiers to the associated field sample results (those analyzed after the ICB, near the CCB, or in the same analytical batch as the method blank) with non-detects or concentrations less than or equal to ten times that in the ICB or CCB according to the guidelines in Table 1 of this SOP. Refer to the NFG for application of data qualifier flags in the event the situation is not defined in Table 1. Document any field sample results requiring qualification on the Qualified Data Table section of the Validation Checklist.
- 7) For GC and GC/MS, verify that the qualitative identification criteria in the analytical method are met for the analytes identified in 10% of the samples. For GC single-component target analytes, the analyte retention time must be within the daily retention time window and either the identification must be confirmed or the analyte must be known to be present at the site. For GC multi-component target analytes, the retention times of the major peaks must be within the daily retention time window and there must be a clearly identifiable pattern. For GC/MS, the internal standard retention times must be within ± 30 seconds of that for the daily standard, the analyte relative retention time must be within ± 0.06 units of that for the daily standard, and the intensities of the characteristic ions must be within $\pm 30\%$ of that for the daily standard. Examine the sample

chromatogram for evidence of poor chromatographic performance (abrupt baseline shifts, excessive baseline rise, poor resolution, peak tailing, or peak splitting), evidence of sample carryover, short run times, or undocumented manual integrations. Refer to the NFG for application of data qualifier flags. Document any field sample results requiring qualification on the Qualified Data Table section of the Validation Checklist.

- 8) For GC with second column/detector confirmation, verify the RPD between the two quantitated results is within the project MQOs. The higher value should be reported unless coelution is suspected. Apply the J data qualifier to all sample results with a high second quantitation RPD. Document any field sample results requiring qualification on the Qualified Data Table section of the Validation Checklist.
- 9) Pesticides breakdown: Evaluate the decomposition of 4,4'-DDT to 4,4'-DDD and/or 4,4'-DDE and the decomposition of endrin to endrin aldehyde and/or endrin ketone on each GC column. The 4,4'-DDT and endrin percent breakdown must be $\leq 20\%$ on each GC column and the combined breakdown for 4,4'-DDT and endrin must be $\leq 40\%$ on each GC column. If the 4,4'-DDT breakdown is $\geq 20\%$ and 4,4'-DDT is detected, apply the "J" qualifier to the detected 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE results; no qualifier is applied to the non-detected results. If the 4,4'-DDT breakdown is $\geq 20\%$ and 4,4'-DDT is not detected, apply the "R" qualifier to the 4,4'-DDT result; apply the "J" result to the 4,4'-DDD, and 4,4'-DDE detections; no qualifier is applied to the non-detected results for 4,4'-DDD and 4,4'-DDE. Follow the same procedure for endrin. Refer to the NFG for application of data qualifier flags in the event that the combined breakdown is $\geq 40\%$. Document any field sample results requiring qualification on the Qualified Data Table section of the Validation Checklist.

Table 1 provides guidance for application of the data qualifiers. The table is not intended to include all situations in which a data qualifier could be assigned. Analytical circumstances surrounding sample analyses are variable and may result in application of data qualifiers due to circumstances not detailed on Table 1. Refer to the National Functional Guidelines for further information on application of data qualifiers.

Documentation

A Data Verification Checklist will be completed to document the data verification and a Data Validation Checklist will be completed to document the data validation process. Both checklists document the validation qualifiers assigned to individual results. The checklists will be included in the project file containing the associated laboratory analytical reports.

DATA USE

Validation qualifiers are assigned to describe the degree to which individual values provide accurate and precise results. The meaning of the qualifiers in terms of future data uses are as follows:

Values that are assigned “J”, “JH”, or “JL” are considered estimated results. Data assigned these qualifiers indicate that they may not be accurate or precise within the limits specified in the QAPP but that the magnitude of the potential imprecision or inaccuracy is not great enough to reject the value for project data uses.

Values assigned “R” do not meet the accuracy or precision project requirements specified to provide quantitative data for the project data uses. The “R” indicates that serious deficiencies were encountered preventing the generation of usable data for the project objectives.

Values are assigned “U” when the value is less than the sample reporting limit or to indicate that a low concentration of the analyte cannot be confirmed due to the presence of interference or the presence of the analyte in associated blanks. “UJ” may be applied to indicate values less than the reported limit may not be accurate or precise. Values with “U” or “UJ” are fully usable and should be considered non-detected. The reported numerical result may be used for project objectives.

Values without qualifiers assigned have met the project MQOs and are suitable for project data uses.

QUALITY ASSURANCE

The Project QA Manager and Project Coordinator will review the completed Data Validation Checklists for conformance with the procedures described herein. Any questions or comments resulting from that review will be resolved before the checklists are considered final. The database manager will modify the project electronic database to include any data qualifiers detailed on a finalized Checklist.

REFERENCES

USEPA *National Functional Guidelines for Inorganic Superfund Data Verification*, OSWER9355.0-131, EPA 540-R-13-001, August 2014.

USEPA *National Functional Guidelines for Superfund Organic Methods Data Verification*, OSWER9355.0-132, EPA-540-R-014-002, August 2014.

Table 1. Guidance for Assignment of Data Qualifiers

QC Check	Outcome	Data Qualifier for Results > SDL	Data Qualifier for Non-Detects
Hold Time	Exceeds hold time	J	UJ
	Improper preservation	J	UJ
	Grossly exceeds hold time	J	R
GC/MS Tune	Outside ion abundance criteria	J	UJ
ICAL	%RSD or r exceeds criteria	J	UJ
	RRF below limit	JH or R	R (or elevate SDL)
ICV/CCV	%R below criteria	JL	UJ
	%R above criteria	JH	None
	%R < 75% (ICP or ICP/MS)	JL or R	R
	RRF < Minimum criteria	JH or R	R (or elevate SDL)
ICB/CCB	Sample result \leq 1x blank value	U	None
	Absolute value of negative ICP blank result > MQL	JL (if result < 2x MQL)	UJ
Method or Equipment blank	Sample result \leq 5x (10x for common laboratory contaminants) blank value	U	None
	Absolute value of negative ICP blank result > MQL	JL (if result < 2x MQL)	UJ
LCS	Recovery <40% (inorganics) or <20% (organics)	JL	R
	Recovery below limit	JL	UJ
	Recovery above limit	JH	None
Matrix Spike ⁽¹⁾⁽²⁾	Recovery <30% (inorganics only) ⁽³⁾	JL	R
	Recovery below limit	JL	UJ
	Recovery above limit	JH	None
Analytical Duplicate ⁽¹⁾	Result \geq MQL and RPD exceeds criteria	J	None
Field Duplicate ⁽¹⁾	Result \geq MQL and RPD exceeds criteria	J	None
Surrogate ⁽⁴⁾	Recovery <10%	JL	R
	Recoveries below limit ⁽⁵⁾	JL	UJ
	Recoveries above limit ⁽⁵⁾	JH	None
	Recoveries above and below limit ⁽⁵⁾	J	UJ
Internal Standard ⁽⁶⁾	Area response <20%	J	R
	Area response below limit	J	UJ
	Area response above limit	J	None

QC Check	Outcome	Data Qualifier for Results > SDL	Data Qualifier for Non-Detects
ICP ICS	Recovery <30%	JL	R
	Recovery below limit	JL	UJ
	Recovery above limit	JH	None
GC Second Quantitation	RPD > 40%	J	None
Pesticide Breakdown	4,4'-DDT or Endrin breakdown \geq 20%	Qualify 4,4'-DDT, 4,4'-DDD, 4,4'-DDE or endrin, endrin aldehyde, endrin ketone detections "J"	Qualify 4,4'-DDT or endrin as "R"; qualify 4,4'-DDD, 4,4'-DDE or endrin aldehyde, endrin ketone detections as "J"

- (1) Qualifiers apply to samples with similar matrix as determined using professional judgment.
- (2) Check waived if the amount of the spike is not at least four times the amount in the unspiked sample.
- (3) If available, PDS results and professional judgment should be used to evaluate whether sample results associated with low-biased MS recoveries should be rejected or qualified as estimated concentrations with potential low bias. Per NFG, results with MS recovery <30% but an acceptable PDS recovery are typically usable.
- (4) Qualifiers apply to target analytes of the same type as the surrogate (e.g., acid or base/neutral for SVOC). Check waived if surrogates diluted out of sample.
- (5) For methods with multiple surrogates, qualifiers apply only if more than one surrogate of a particular type is deficient.
- (6) Qualifiers apply to target analytes quantitated with the internal standard.

DATA VERIFICATION CHECKLIST				
Client Name:		Project Number:		
Property Location:		Project Manager:		
Laboratory:		Laboratory Job No.:		
Reviewer:		Date Checked:		
ITEM	Yes	No	NA	Comment Number
Chain of Custody (C-O-C) and Sample Receipt at Lab				
1. Signed C-O-Cs included and seals used?				
2. Date and time of sample collection included?				
3. Sample receipt temperature $\leq 6^{\circ}\text{C}$?				
4. Samples preserved appropriately?				
5. No problems noted?				
6. Field quality control sample frequency met project requirements?				
Laboratory Report and Data Package				
7. Laboratory Review Checklist and Exception Report				
8. Analytical discrepancies noted?				
9. Field sample identifications (IDs) included?				
10. Laboratory sample IDs included?				
11. All samples analyzed				
12. Date of analysis included?				
13. Date of sample preparation included?				
14. Samples prepared within holding time?				
15. Samples analyzed within holding time?				
16. Detection limit and quantitation limit included?				
17. DCS results support SDL?				
18. Elevated reporting limits justified?				
19. Method references included?				
20. Sample matrix included?				
21. Sample result units reported correctly?				
22. Soil/ sediment results corrected for dry-weight?				
23. Calibration data acceptable?				
24. ICV and CCV recoveries within data qualification criteria?				
25. ICB and CCB results <MQL?				
26. Method blank results <MQL?				
27. Equipment and Trip blank results <MQL?				
28. All analytes included in LCS?				
29. LCS recovery within project control limits?				

ITEM	Yes	No	NA	Comment Number
30. MS/MSD recoveries within project control limits?				
31. Metals PDS recoveries reported and within project control limits?				
32. LCS/LCSD RPDs within project control limits?				
33. MS/MSD RPDs within project control limits?				
34. Laboratory duplicate RPDs within project control limits?				
35. Field duplicate RPDs within project control limits?				
36. Surrogate recoveries within project control limits?				
37. Internal standard areas within project control limits?				
38. Completeness percentage within project limits?				
<p>Definitions:</p> <p>CCB – Continuing Calibration Blank; CCV – Continuing Calibration Verification; DCS – Detectability Check Sample; ICB – Initial Calibration Blank; ICV – Initial Calibration Verification; LCS – Laboratory Control Sample; LCSD – Laboratory Control Sample Duplicate; MDL – Method Detection Limit; MQL – Method Quantitation Limit; MS/MSD – Matrix Spike/Matrix Spike Duplicate; PDS – Post-digestate spike; RPD – Relative Percent Difference</p>				
<p>COMMENTS</p>				

DATA VALIDATION CHECKLIST				
Client Name:		Project Number:		
Property Location:		Project Manager:		
Laboratory:		Laboratory Job No.:		
Reviewer:		Date Checked:		
ITEM	Yes	No	NA	Comment Number
Laboratory Report and Raw Data Package				
1. Sample results calculated and transcribed correctly?				
2. Quality control parameters calculated and reported correctly?				
3. GC/MS tuning performance within criteria?				
4. GC/MS RRF above minimum criteria?				
5. GC/MS and GC RSD (or r) calibration meet criteria?				
6. ICP ICS recoveries within criteria?				
7. ICP ICB/CCB absolute value of results <MQL?				
8. GC qualitative identification criteria met?				
9. GC/MS qualitative identification criteria met?				
10. GC second confirmation %D criteria met?				
Definitions: %D – Percent difference; CCB – Continuing Calibration Blank; CCV – Continuing Calibration Verification; GC/MS – Gas Chromatography/Mass Spectrometry; ICB – Initial Calibration Blank; ICP – Inductively-Coupled Plasma; ICS – Interference Check Sample; ICV – Initial Calibration Verification; MQL – Method Quantitation Limit; r – Correlation Coefficient; RRF – Relative Response Factor; RSD – Relative Standard Difference				
COMMENTS				

SET SUMMARY
Laboratory Job No: _____

	Number of Field Samples including Field Duplicates ()
	Number of Field MS/MSD Pairs
	Number of Equipment blanks
	Number of VOC Trip Blanks
	Number of Parameters (VOC, SVOC, Pesticides, Herbicides, Metals)
	Number of Target Analytes per Sample
	Total Measurements for Field Samples
	Number of measurements with no validation qualifier (i.e., “none” in EDD)
	Number of measurements with UJ flag (<i>summarize affected analytes and reason</i>)
	Number of measurements with JL flag (<i>summarize affected analytes and reason</i>)
	Number of measurements with J flag (<i>summarize affected analytes and reason</i>)
	Number of measurements with JH flag (<i>summarize affected analytes and reason</i>)
	Number of measurements with U flag (<i>summarize affected analytes and reason</i>)
	Number of measurements with R flag (<i>summarize affected analytes and reason</i>)
	Completeness-to-date for field samples for given media (project goal 90%)
	Completeness-to-date for all COPCs combined for given media (project goal 90%)
	Completeness-to-date for each COPC individually for given media (project goal 80%)

Usability: *Provide usability summary noting any elevated reporting limits, cases of professional judgment, and data that is rejected for use. Measurements qualified as estimated (JL, J, JH) are suitable as qualified for the intended use. Measurements qualified with U-flag should be considered not present at the concentration reported.*

[illegible]

APPENDIX B

RESERVED FOR PLAN ADDENDA